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Forest Insect and Disease Conditions in the United States 1978

Foreword

This is the 28th annual report of forest insect and disease conditions in the United States. It was compiled by the Forest Insect and Disease Management Staff, State and Private Forestry, Washington Office, to provide land managers and others with information about the impact, distribution, and trends of major insect and disease pests.

The information in this report was supplied by homeowners; managers of private, commercial, State, and Federal lands; personnel in forestry research; and State and Federal pest control personnel.

Limited funds and inflation make it extremely important to use resources in a way that will benefit the most people and make it mandatory to protect our forest resources from pests in the most efficient manner. This is possible only if information is available on the relative impact of each pest and on the most effective means of controlling that pest. This report lists the impact of each pest and, if known, the alternative biological, silvicultural, and chemical controls for the major pests. This information will assist the legislator in setting budget priorities and the land manager in establishing management alternatives.

Detailed information on any of the pests discussed in this report can be obtained directly from the Forest Service Regional Offices.

We appreciate the assistance of all State, Federal, and private cooperators who provided information for this report, and recognize the efforts of Leon LaMadeleine and Donald Goheen in compiling this report.

Peter W. Orr, *Staff Entomologist*

H. Daniel Brown, *Staff Pathologist*

Forest Insect and Disease Management
Forest Service, U.S. Department
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Washington, D.C. 20013

This publication reports information involving pesticides. It does not contain recommendations for their use, nor does it imply the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

Caution: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Common names of the insects discussed in this report are approved by the Entomological Society of America (ESA) or are widely accepted and commonly used. The ESA approved common names are indicated in the Insect Index. Scientific names of disease-causing agents are changed as additional studies are made. Recently approved new names are listed with the previously used names in such cases for the information and convenience of the reader.

May 1980

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Forest Insect and Disease Conditions in the United States, 1978

Eastern Conditions

The spruce budworm, gypsy moth, and southern pine beetle were the most significant insects in the Eastern United States in 1978. The spruce budworm defoliated trees on 7.7 million acres, 17 percent more than in 1977. Acreage defoliated increased by 22 percent in Maine to 7 million acres and by 41 percent in Vermont to 62,000 acres. In Michigan, Minnesota, Wisconsin, and New Hampshire, the amount of defoliation caused by this insect decreased or remained the same as in 1977.

There was an overall decrease in defoliaion caused by the gypsy moth, mainly because there was a 65-percent decrease in defoliation in Pennsylvania and a 52-percent decrease in Massachusetts. Acreages affected tripled in New Jersey and increased fivefold in New York and Vermont. The gypsy moth is considered to be established in Michigan, North Carolina, and Virginia and populations are increasing in Wisconsin.

The number of southern pine beetle infestations increased in Georgia (100 spots) and was significant in Mississippi (2,300 spots). Infestations in Texas, Arkansas, Louisiana, Oklahoma, and Alabama decreased sufficiently to allow control by State agencies.

Other significant insects include: the fall cankerworm and coneworms in the South, and the forest tent caterpillar and oak leaf tier complex in the North. The fall cankerworm defoliated 109,000 acres, primarily in North Carolina and Georgia. The coneworms, significant in seed orchards, reduced cone crops from 35 to 60 percent in some areas. Over 600,000 acres were defoliated by the forest tent caterpillar in Indiana, Minnesota, Wisconsin, New Hampshire, Massachusetts, New York, and Vermont. A collapse of this insect is expected in Indiana. The oak leaf tier complex defoliated approximately 200,000 acres in Massachusetts, West Virginia, and New Jersey.

Scleroderris canker, fusiform rust, nursery diseases, pitch canker, and annosus root rot were the major disease problems in the East. There was a resurgence of the North American strain of scleroderris canker in northern Wisconsin and the Upper Peninsula of Michigan. More areas infested by the European strain, the more virulent strain which can kill mature trees, have been found in New York and Vermont. This strain was confirmed for the first time in Ontario. It is also suspected to be present in New Hampshire.

Nursery diseases killed millions of seedlings in nurseries in the North and South and in newly planted areas in the North. Stunting of approximately 4 million seedlings in Federal nurseries in Minnesota and Michigan and State nurseries in Wisconsin will reduce the probability of these seedlings surviving when outplanted. Better fumigation techniques and recent successes with the introduction of mycorrhizal fungi into nursery beds have produced cautious optimism about the possibility of reducing losses to pathogens in seedbeds and increasing seedling survival after outplanting.

Fusiform rust is now present in 10 Southern States, where approximately 100 million board feet of timber is lost annually to the disease. Infection of nursery stock has been controlled with a fungicide.

The number of plantations affected by pitch canker in Florida has increased but there has been a decline in the severity of the disease throughout the South.

Although the incidence of annosus root rot is relatively high in some areas in South Carolina and Georgia, where there are high hazard sites and no stump treatment has been done, the disease incidence has decreased in areas of low hazard sites or where stump treatment has been done.

Weather conditions in 1978 were conducive to infection by needlecast diseases. These diseases caused extensive damage in some local areas in the North and were widespread with moderate rates of infection throughout the East.

Western Conditions

The western spruce budworm and mountain pine beetle were the most damaging insect pests in forests of the Western United States this year. Other harmful insects causing important damage included the western pine beetle, Douglas-fir beetle, spruce beetle, and Douglas-fir tussock moth. Many other insects, including forest tent caterpillars, needle miners, ips beetles, sawflies, and seed and cone insects, were damaging in local areas.

Western spruce budworm defoliated Douglas-fir and true fir on just under 5.2 million acres. The area defoliated increased over that of 1977 in southern Idaho, southwestern Montana, Wyoming, Colorado, and parts of northern Arizona and New Mexico. Budworm populations declined and the area defoliated decreased in Oregon, Washington, northern Idaho, northwestern Montana, and parts of Arizona and New Mexico. The spruce budworm was found for the first time around Anchorage, Alaska.

The Mountain pine beetle killed lodgepole, ponderosa, and limber pine on about 4 million acres. Colorado, Montana, Idaho, Wyoming, Oregon, and Washington reported major infestations. Scattered tree killing occurred in Arizona and New Mexico. Mountain pine beetles also killed substantial numbers of vigorous young sugar pines in northern California.

Western pine beetle outbreaks continued in ponderosa pine stands in central and southern Sierra Nevada of California and in eastern Oregon and Washington. Scattered tree killing by this insect also occurred in southwestern Idaho, Arizona, and New Mexico.

The Douglas-fir beetle was active in southern Idaho. Populations declined in Oregon and Washington, but 46,450 acres were affected nonetheless. Scattered tree killing occurred in northern Idaho and Montana.

The Spruce beetle was the most damaging insect in Alaska, killing trees on more than 125,800 acres. Tree killing also occurred in northeastern Washington and to a lesser degree in northern Idaho, Montana, Wyoming, Colorado, Arizona, and New Mexico.

Douglas-fir tussock moth larvae defoliated Douglas-fir and true firs on about 10,000 acres in southcentral Oregon and 7,000 acres in New Mexico. Populations were generally low in other parts of the West except in local area in California and Colorado.

Dwarf mistletoes and root pathogens remained the most important disease-causing agents in the West. Foliage diseases were particularly prevalent this year. Other diseases of local significance included rusts, decays, nursery diseases, and air pollution.

Dwarf mistletoes continued to damage most conifer species throughout the West. Infections caused growth loss and tree mortality. Precise impact data is still lacking, but observations indicate that losses are tremendous. Surveys to develop impact data are underway and figures should be available soon.

Root diseases caused significant tree mortality in many areas. Laminated root rot affected about 5 percent of the Douglas-fir area in Oregon and Washington. Armillaria root rot caused damage throughout the West. Large infection centers were found in eastern Oregon, northern Idaho, Montana, and Colorado. Annosus root rot was found associated with bark beetles in California and with other pathogens in northern Idaho, was reported for the first time in Colorado on white fir, and was found infecting up to 30 percent of the stems in Oregon and Washington's western hemlock stands. Black-stain root disease continued to be found in Oregon, Washington, California, Idaho, and Colorado.

The incidence of foliage diseases was high in many parts of the West, probably due to moist conditions in the spring of 1978. These diseases probably caused some growth loss but little or no mortality.

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Northern Region (R-1)[1]

Forest Insect and Disease Conditions by Region

Jerald E. Dewey and Clinton E. Carlson
Forest Insect and Disease Management
State and Private Forestry
Missoula, Mont.

Conditions in Brief

Major mountain pine beetle infestations on five National Forests and two National Parks in the Region killed more than 48 million lodgepole pines on 866,000 acres and 500,000 ponderosa pines on 80,000 acres this year. Fir engraver beetles killed subalpine fir on more than 7,000 acres on nine National Forests in Montana and Idaho. The Douglas-fir beetle and spruce beetle caused only minor damage. Western spruce budworm defoliation decreased by 1.2 million acres, but these insects destroyed cones of Douglas-fir, grand fir, and western larch. Defoliation of western larch by the larch casebearer was masked by the occurrence of a needle disease caused by *Meria laricis* Vuill. The forest tent caterpillar defoliated 150,000 acres of aspen in North Dakota. Spring and fall cankerworms defoliated Siberian elm shelterbelts in North Dakota. Douglas-fir tussock moth populations remained low. Other insects causing minor damage to ponderosa pine were the pine butterfly, a needle miner, and the gouty pitch midge; and to western larch, two species of sawflies.

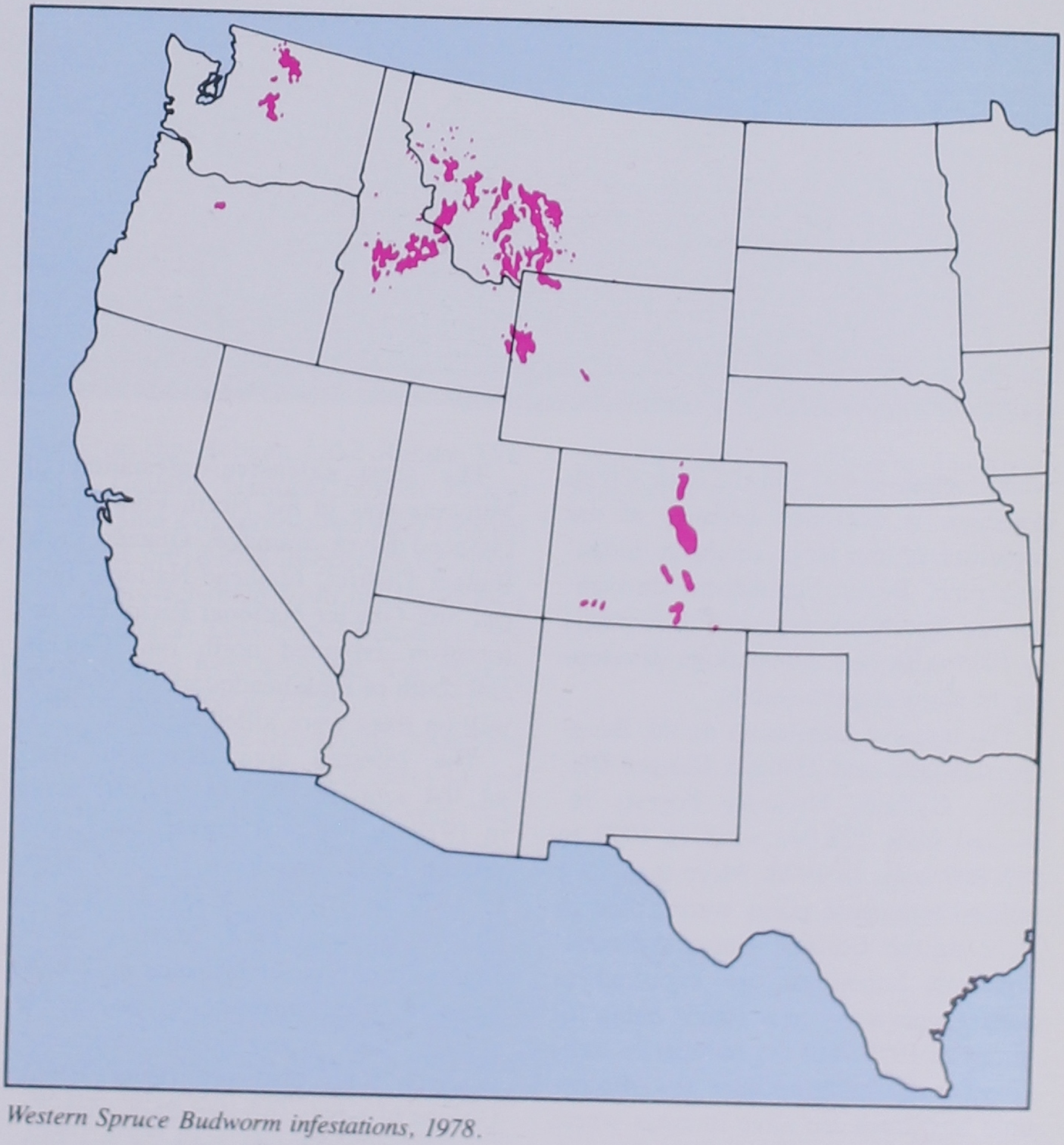
Dwarf mistletoe, nursery diseases, root rots, and air pollution were the major diseases damaging trees. The range of lodgepole pine dwarf mistletoe was extended by two counties. Seedling root diseases, gray mold, and needle pathogens killed several million seedlings at Coeur d'Alene Nursery. About 3 million cubic feet of timber was killed by air pollutants emitted from a smelter in Anaconda, Mont.

Infection centers of shoestring root rot and several other root rotting fungi were common in the eastern part of the Region. Volume loss caused by dwarf mistletoe is estimated at 90.3 million cubic feet; from root diseases, 86.7 million; and from air pollution, 16.5 million.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Mountain pine beetle infestations in mature lodgepole pine stands in Montana increased in 1978. Major infestations exist on the Beaverhead, Gallatin, Flathead, Lolo, and Kootenai National Forests and in Glacier and Yellowstone National Parks.

The number of acres of killed lodgepole pine increased from 20,000 in 1977 to 79,900 in 1978 on the Ennis Ranger District, Beaverhead National Forest. Most tree mortality occurred along tributaries of the Madison River. About 16,400 acres of whitebark pine also were infested at higher elevations in the Madison River drainage. The epidemic,



Western Spruce Budworm infestations, 1978.

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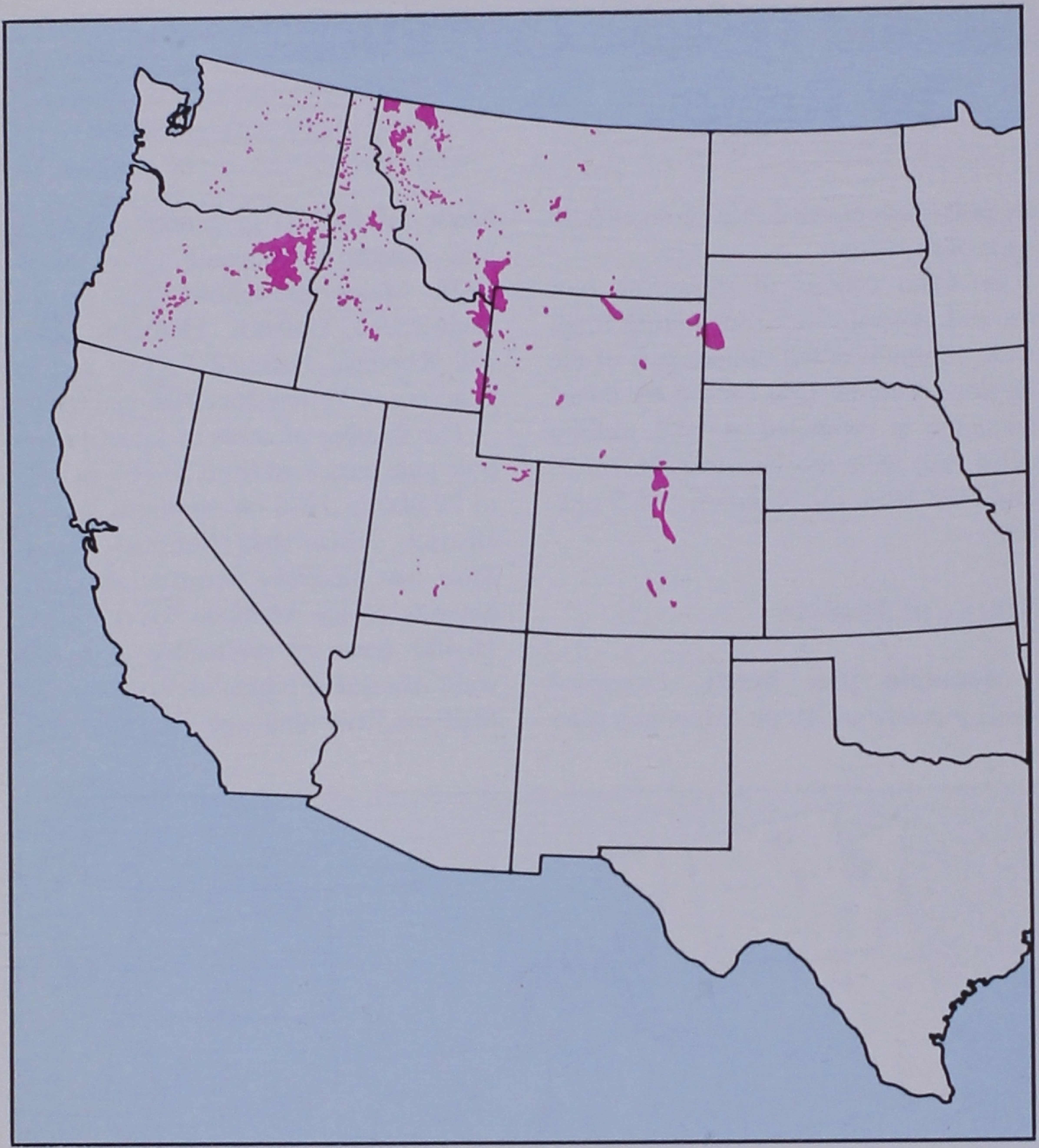
[1] Includes forests in Montana, northern Idaho, North Dakota, northwestern South Dakota, and National Park Service lands in northwestern Wyoming.



Infestations of the mountain pine beetle (all hosts), 1978.

which began in 1972 in the Jack Creek drainage, is declining because of the depletion of the large diameter lodgepole pine. Beetle populations throughout the forests are expected to increase in 1979 with new infestations developing in many mature stands.

The massive infestation on the Bozeman-Gallatin and Hebgen Ranger Districts, Gallatin National Forest, increased from 272,941 acres in 1977 to 296,809 acres in 1978. More than 15.4 million lodgepole pines were killed in 1978 on the Gallatin National Forest. Epidemic conditions are expected to persist with many new stands being infested in 1979, but the number of trees killed is declining because few susceptible host trees are alive in areas where the infestation began in 1969.

The most extensive infestation in Montana was in the North Fork of the Flathead River drainage, Glacier View Ranger District, Flathead National Forest, and Glacier National Park. The infestation extended north into Canada and south of Park headquarters. Over 22 million trees were killed in 1978.

The infested area increased from 44,364 acres in 1977 to 108,603 acres in 1978 on National Forest, State, and private lands, and from 142,878 acres in 1977 to 164,017 acres in 1978 in Glacier National Park. Massive beetle flights from Glacier National Park continue to infest surrounding susceptible stands, and many small diameter, younger trees also are being killed. Groups of newly infested trees were detected in the Middle Fork of the Flathead River drainage as far east as Essex, Mont., and around mill yards at Columbia Falls and Olney, Mont. Groups of current year faders were observed at Little Bitterroot, Ashley, Rodgers, and McGregor Lakes on the Whitefish Ranger District. Infestation are developing and spreading into stands in the Middle, North, and South Forks of the Flathead River drainage, and on the Tally Lake and Swan Lake Ranger Districts. More than 300 million lodgepole pines could be killed within the next 8 years on the Flathead National Forest if the infestation continues.

Much of the lodgepole pine throughout the Thompson River drainage of the Plains Ranger District, Lolo National Forest, has been killed by the beetle. The infested area increased from 10,514 acres in 1977 to 14,693 acres in 1978. The number of trees killed increased from about 240,000 in 1977 to over 1 million in 1978.

About 400,000 ponderosa pines were killed in 1978 in second-growth stands on the Blackfoot and Clark Fork River drainages north and east of Missoula, Mont. Infestations are still building in the Ninemile drainage and near St. Regis, Mont. Beetle infestations are expected to increase in size and intensity in 1979, resulting in an even greater loss of timber.

On the Kootenai National Forest, more than 230,000 trees were killed on 21,700 acres in 1977. This increased to more than 630,000 trees killed on 29,800 acres in 1978. The most intensive infestation is in the Yaak River drainage, Yaak Ranger District. However, scattered groups of red-topped trees, ranging from 5 to 1,000 trees per group, exist on the Rexford, Fortine, Libby, and Fisher River Ranger Districts. All infestations are expected to increase in size and intensity in 1979.

Infestations in second-growth ponderosa pine stands declined from 81,800 acres in 1977 to 64,400 acres in 1978 on the Lewis and Clark National Forest. The number of infested trees decreased from 573,000 in 1977 to 64,400 in 1978. These infestations will remain

F–701505

Spraying Sevimol-4 for protection against mountain pine beetle.

static or continue to decline until windstorms, snow breakage, or other factors provide favorable conditions for another bark beetle population buildup.

An infestation in mixed lodgepole-ponderosa pine stands on the Sula Ranger District, Bitterroot National Forest, declined in 1978. The number of infested trees decreased from 108,300 in 1977 to 5,185 in 1978. A continued decline is expected in 1979.

The infestation in Yellowstone National Park expanded from 129,280 acres in 1977 to 171,244 in 1978. More than 8.9 million trees were killed in 1978. This infestation will continue to spread north in the Park and in adjacent stands on the Gallatin National Forest in 1979.

In campgrounds and administrative sites on the Hebgen Lake Ranger District, Gallatin National Forest, 10,830 high-value lodgepole pines were sprayed with the preventive insecticide Sevimol-4® to protect them from mountain pine beetle attack. Less than 1 percent of the treated trees were attacked. The project will be repeated in 1979.

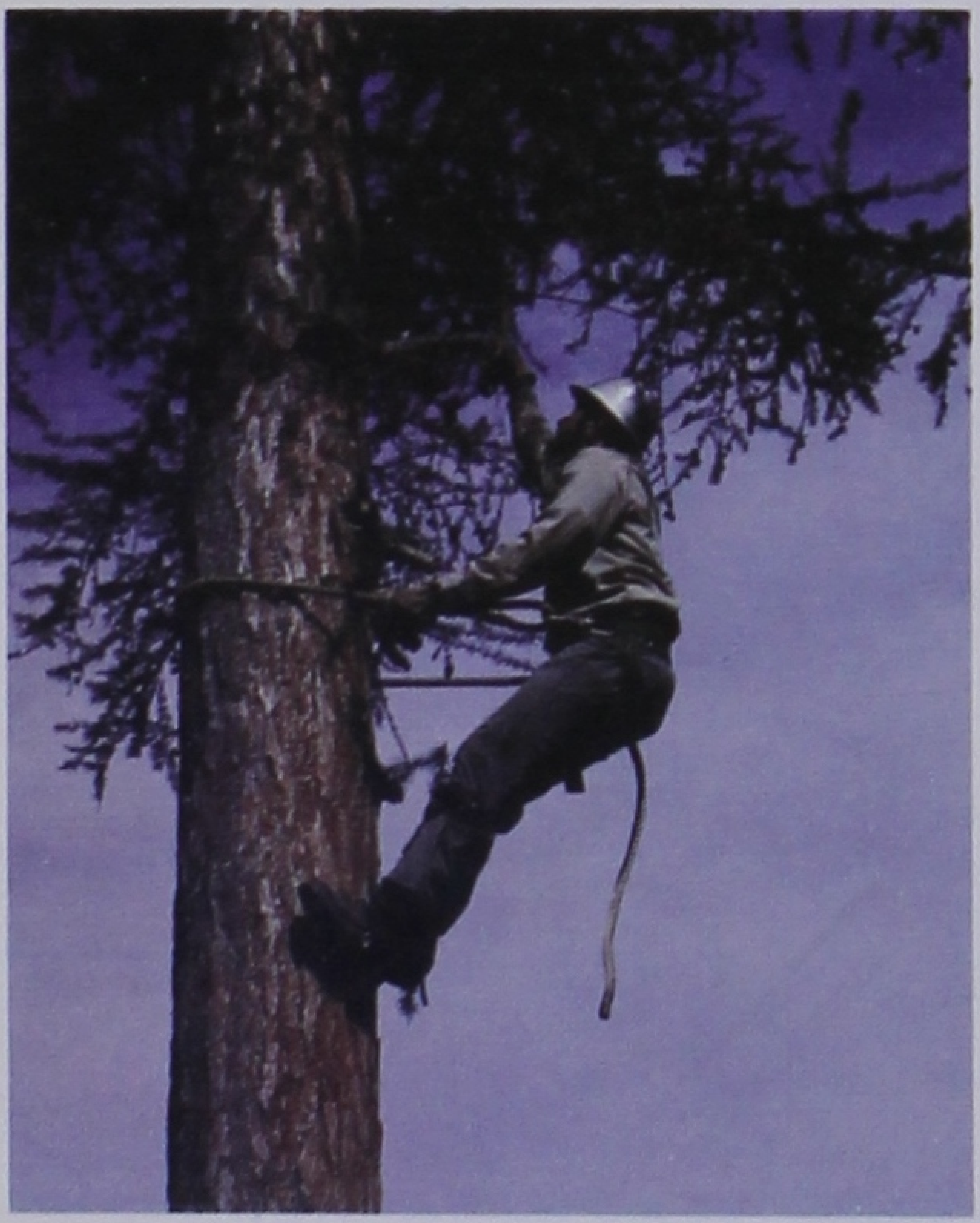
Lodgepole pine tree killing continued for a second year on 800 acres in the Salmon River Breaks, Bitterroot National Forest, Idaho. Additional mortality is expected in 1979 because these stands contain many mature, large diameter trees that are susceptible to beetle attack.

Western spruce budworm, *Choristoneura occidentalis* Free. The western spruce budworm epidemic declined in many areas in 1978, but increased sub-

Table 1.—*Defoliation caused by western spruce budworm in the Northern Region in 1977 and 1978*[1]

Area[2] and State	Year of defoliation 1977	Year of defoliation 1978	Change in size of infestation
	Acres		
Idaho			
Clearwater National Forest	286,407	8,115	– 278,292
Idaho Panhandle National Forest	176,454	7,416	– 169,038
Nezperce National Forest	184,315	4,590	– 179,725
Subtotal	647,176	20,121	– 627,005
Montana			
Beaverhead National Forest	173,250	223,720	+ 50,470
Bitterroot National Forest[3]	451,495	379,112	– 70,383
Custer National Forest	7,370	3,625	– 3,745
Deerlodge National Forest	183,207	382,762	+ 199,555
Flathead Indian Reservation	129,438	50,566	– 78,872
Flathead National Forest	54,527	15,171	– 39,356
Gallatin National Forest	427,990	293.265	– 134,725
Helena National Forest	462,979	575,151	+ 112,172
Kootenai National Forest	20,029	14,604	– 5,425
Lewis and Clark National Forest	116,499	176,294	+ 59,795
Lolo National Forest	947,941	281,161	– 666,780
Subtotal	2,974,725	2,395,431	– 579,294
Wyoming			
Yellowstone National Park	79,330	104,694	– 25,364
Grand Total	3,701,231	2,520,246	– 1,180,985

[1] 25 percent or more of current foliage is destroyed.
[2] Infested acreage includes Federal, State, and private lands.
[3] A portion of this Forest is in north Idaho. (34,605 acres in northern Idaho were defoliated in 1978.)



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Collecting western larch cones to assess cone and seed insects impacts.

stantially on the Beaverhead, Deerlodge, Helena, and Lewis and Clark National Forests and in Yellowstone National Park. Defoliation decreased from 3.7 million acres in 1977 to 2.5 million in 1978. Moderate to heavy defoliation is expected on the Helena and Gallatin National Forests in 1979.

Regeneration pests. Planting procedures, damage by stock animals and wildlife, and spruce budworm were major causes of seedling loss or damage on 97 sites planted within the past 5 years on the Lolo, Flathead, Clearwater, and Nezperce National Forests.

Forest tent caterpillar, *Malacosoma disstria* Hbn. Populations of this caterpillar were epidemic in Manitoba, Canada, and in Minnesota during the 1970's. By 1976, these outbreaks had reached North Dakota's Turtle Mountains. In 1978, heavy defoliation of aspen occurred on about 150,000 acres. Despite heavy larval and pupal mortality caused by parasites and diseases, new egg masses were found in tree crowns at 42 of 63 plots sampled. Defoliation in 1979 is expected to be spotty and light throughout the aspen stands of the Turtle Mountains. Several spots of moderate defoliation are expected around Lake Metigoshe and east of Carpenter Lake.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.).Tussock moth populations remain very low in the Region. Only one male moth was collected from the 12 sites that were surveyed with pheromone-baited traps in Idaho. Moths were trapped at six of the nine plots surveyed in Montana. Because so few moths were trapped, an outbreak is not expected next year.

Larch casebearer, *Coleophora laricella* (Hbn.). Defoliation caused by the larch casebearer was masked this year by a needle disease on western larch caused by *Meria laricis* Vuill. Feeding damage was quite noticeable, however, around Seeley Lake, Mont., for the first time.

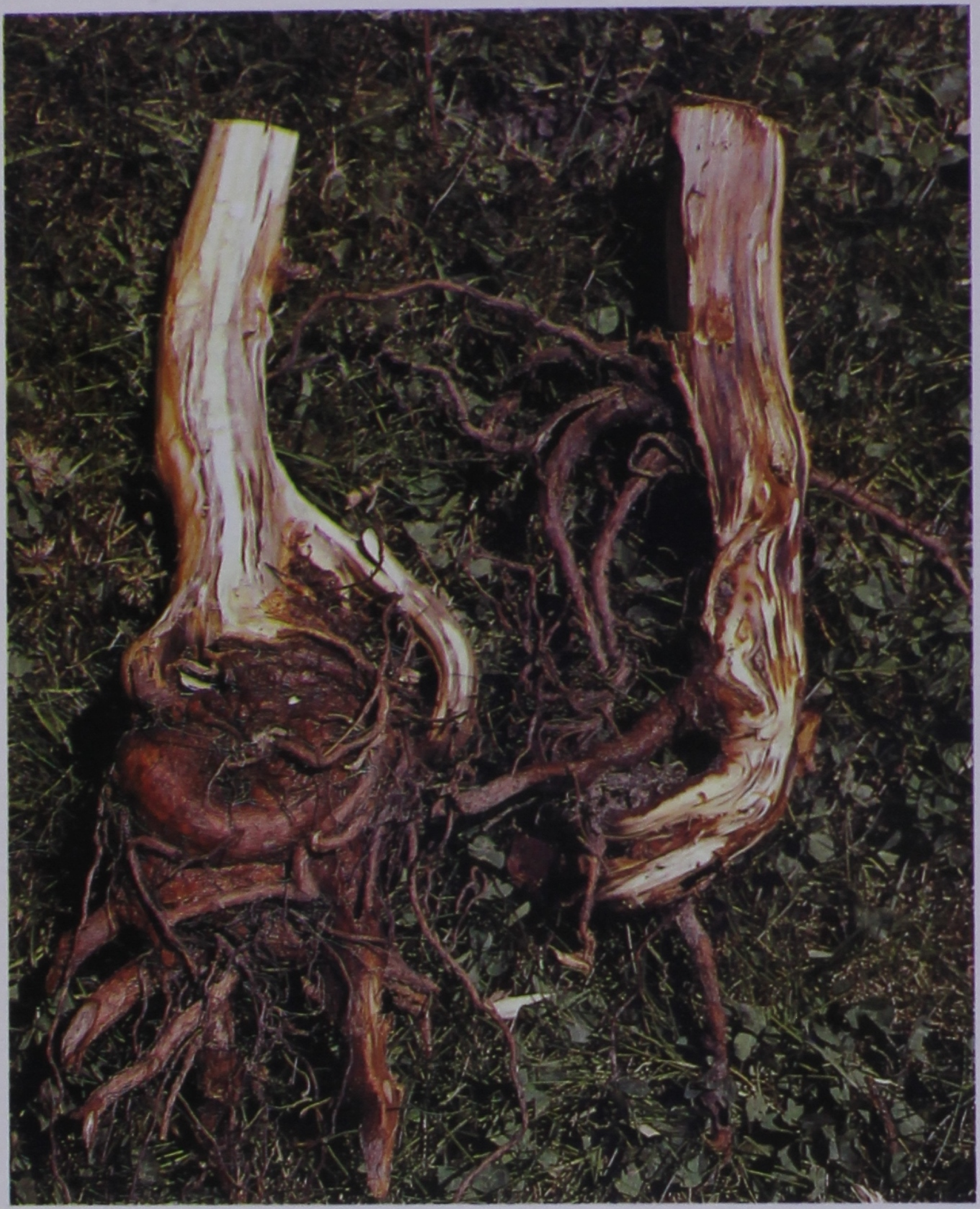
Up to 60 percent parasitism by *Agathis pumila* (Ratz.) and 30 percent by *Chrysocharis laricinellae* (Ratz.) occurred in infestations near Columbia Falls, Mont., and Priest River, Idaho. Parasite collections from these areas were made in April for release by cooperators in Oregon and Washington.

Cone and Seed Insects. Twenty-one seed production areas in the Region were surveyed for incidence and impact of cone and seed insects. Tree species evaluated were Douglas-fir, grand fir, western larch, ponderosa pine, lodgepole pine, and western white pine. Damage varied considerably among seed production areas and tree species. Greatest damage to cones of Douglas-fir, grand fir, and western larch were caused by western spruce budworm (*Choristoneura occidentalis*), midges (*Contarinia* spp.), and cone worms (*Dioryctria* spp.). Ponderosa pine was most severely damaged by cone worms

(*Dioryctria* spp.). The mountain pine cone beetle (*Conophthorus monticolae* Hopk.) was the primary pest of western white pine cones. This beetle destroyed 67 percent of the high value, genetically superior western white pine cones produced at the Sandpoint, Idaho, seed orchard. Approximately 8,000 beetle-infested cones were sent to the Insecticide Evaluation Project at Berkeley, Calif., to screen insecticides for control of this insect in seed orchards and seed production areas. Lodgepole pine cones were damaged less than any other tree species by insects.

Other Insects (R-1)

Insects	Host	Location	Remarks
Pine engraver, *Ips pini* (Say)	Lodgepole pine	Idaho Panhandle National Forest; Lolo National Forest, Montana	Populations declining.
Pityophthorus pseudotsugae (Sw.) *Cryphalus ruficollis* (Hopk.)	Subalpine fir	Idaho and Montana. Most severe on Idaho Panhandle, Flathead, and Gallatin National Forests.	Infestation declined to 7,343 acres.
Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk.	Douglas-fir	Regionwide	Population at low levels, only small areas of infestation.
Spruce beetle, *Dendroctonus rufipennis* (Kby.)	Engelmann spruce	Regionwide	Populations at low levels, only small areas of infestation.
Spring cankerworm, *Paleacrita vernata* (Peck) Fall cankerworm, *Alsophila pometaria* (Harr.)	Siberian elm	North Dakota	Defoliating shelterbelts; *Bacillus thuringiensis* (B.t.) is a promising control agent.
Pine butterfly, *Neophasia menapia* (F. & F.)	Ponderosa pine	Flathead Indian Reservation, Mont.; National Bison Range, Mont.	Defoliated area decreased to 383 acres.
Needle miner, *Coleotechnites* sp.	Ponderosa pine	Flathead Indian Reservation, Mont.; Univ. of Montana campus	Defoliated area decreased to 3,182 acres.
Sawflies, *Anoplonyx* sp. and *Pristiphora erichsonii* (Hart.)	Western larch	Montana	Present but masked by needle diseases.
Gouty pitch midge, *Cecidomyia piniiopsis* O.S.	Ponderosa pine	Northern Idaho	Caused shoot mortality on saplings over a wide area.



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Verticicladiella infected root systems of 12- to 15-year-old machine-planted Douglas-fir. Note compaction of roots and brown stain in the stem.

Status of Diseases

Nursery Diseases. Diseases caused significant losses in bare root and container grown stock. Gray mold, *Botrytis cinerea* Pers. ex Fr., killed 90 percent of the western larch tublings at one nursery and 17,000 containerized seedlings outplanted on one district. The problem was caused by storage of seedlings inside an old, damp barn with large amounts of moldy straw during a very moist period.

Root pathogens, primarily *Fusarium* spp., caused mortality in some seedlots of Douglas-fir, western larch, ponderosa pine, and lodgepole pine. Losses approached 25 percent in seedbeds and 10 percent in greenhouses.

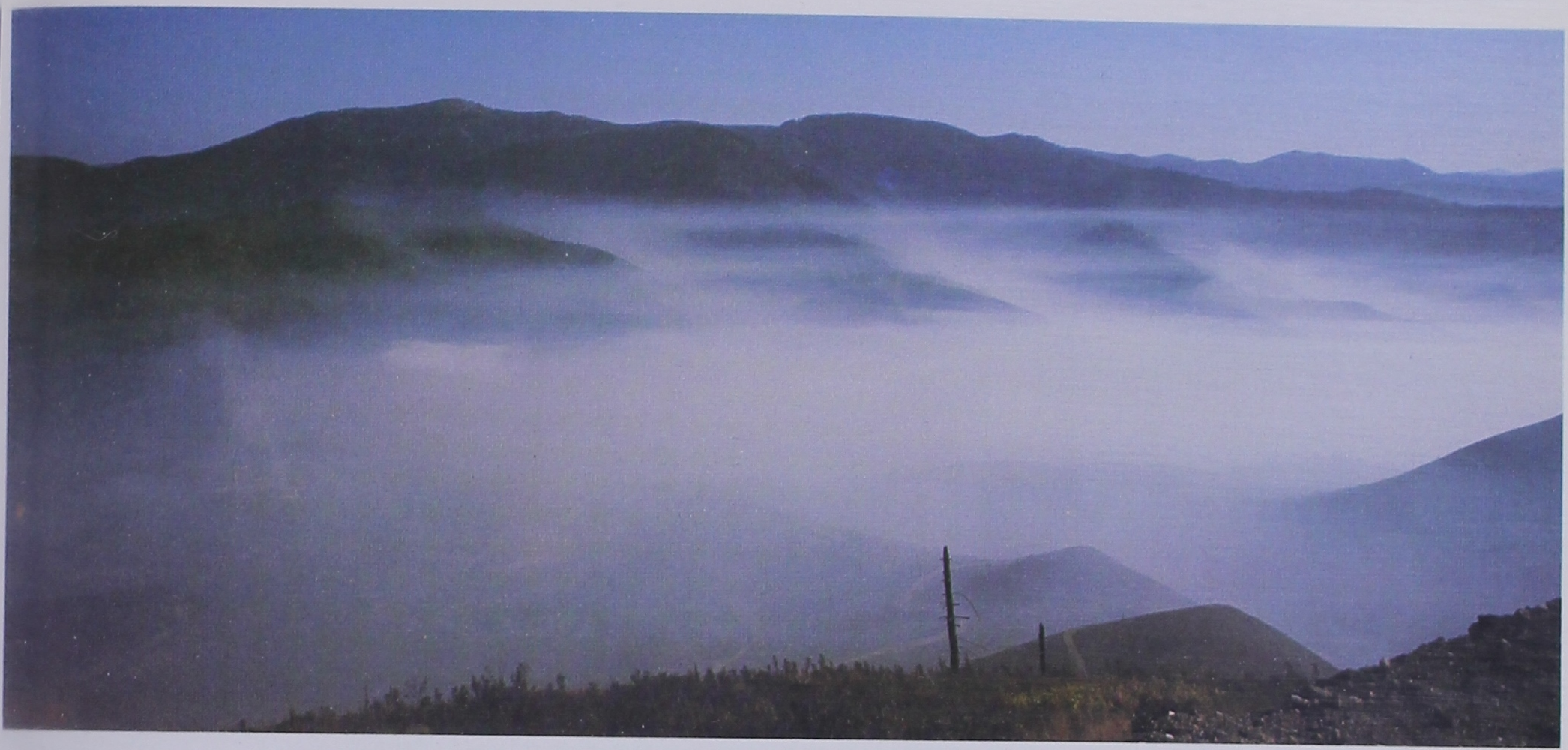
Severe discoloration of western larch, resulting largely from infection by *Meria laricis* Vuill., occurred on the Kootenai, Flathead, Clearwater, and Idaho Panhandle National Forests. Minor amounts of defoliation resulted from *Hypodermella laricis* Tub. and *Melampsora* sp. infections scattered throughout the range of western larch.

Root Diseases. About 6,000 acres of shoestring root rot centers, caused by *Armillariella mellea* (Vahl ex Fr.) Karst., were found throughout the Rocky Mountain Division of the Lewis and Clark National Forest, west into the Flathead National Forest, south into the Lolo National Forest and as far east as the eastern edge of the Jefferson Division of the Lewis and Clark National Forest. The centers ranged in size from a few acres to nearly a thousand acres and seemed to be associated with Douglas-fir in Douglas-fir–subalpine fir habitat types, often on highly permeable limestone soils.

A species of *Verticicladiella* was found associated with abundant mortality of 50- to 60-year-old eastern white pine on the Idaho Panhandle National Forests. The same fungus was found associated with mortality of machine-planted 15- to 17-year-old Douglas-fir on the Lincoln Ranger District of the Helena National Forest. Staining and mortality were always associated with poor root systems, which may have been the result of improper planting.

Three other root pathogens—*Fomitopsis annosa* (Fr.) Karst., *Polyporus tomentosus* Fr., and *Phaeolus schweinitzii* (Fr.) Pat.—together caused widespread root decay of mature Douglas-fir in northern Idaho, predisposing these affected trees to blowdown. Blowdown of mature Douglas-fir leave trees (shelterwood and seed tree cuts) occurred in northwest and west-central Montana. Roots were extensively decayed, often resulting in truncated buttress roots 2 to 3 feet below ground. Direct mortality from decay was not observed.

White pine blister rust, *Cronartium ribicola* J.C. Fisch. The final evaluation of a 10-year study concerning the effectiveness of eradicating *Ribes* to control white pine blister rust in Yellowstone National Park was completed in 1978. *Ribes* eradication was suspended during 1968-78 in 18 white pine (*Pinus albicaulis* and *P. flexilis*) stands to permit the currants and blister rust to increase naturally within the control units. Eleven stands outside the control units were selected as checks. The eradication of



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F-701508

Ribes did not effectively limit the spread and intensification of white pine blister rust in Yellowstone National Park.

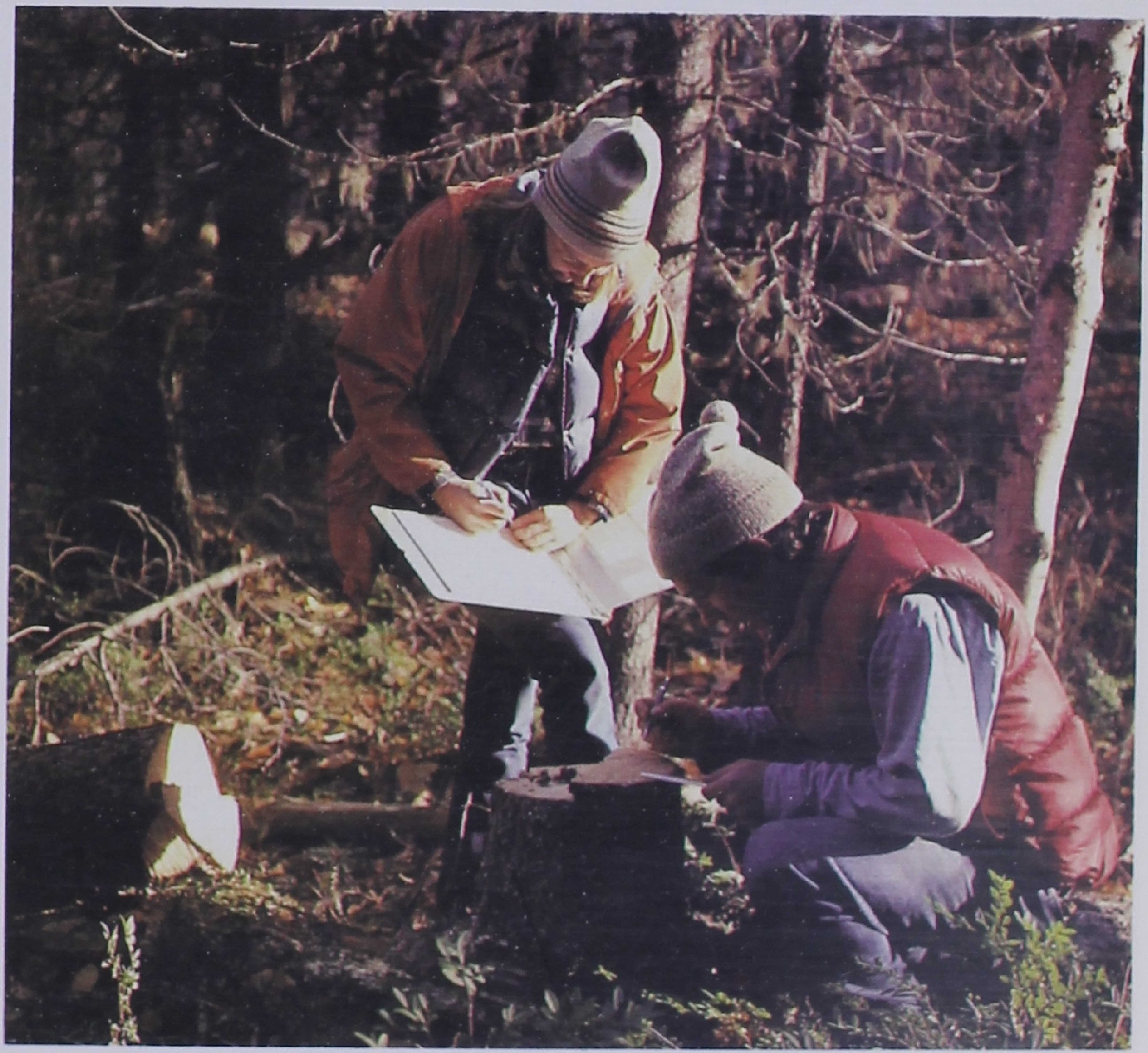
Air Pollution. Three evaluations of the effect of sulfur dioxide and fluoride pollution were completed this year. The first, near a lead smelter at Helena, Mont., was made in cooperation with the State. This evaluation caused the State to require the plant to reduce sulfur dioxide emissions from 300 tons per day to 80 tons per day.

The second evaluation resulted in an injunction against an aluminum reduction plant at Columbia Falls, Mont., requiring a reduction of fluoride emissions from 4,000 pounds per day to 200 pounds per day.

The third evaluation was near a copper smelter at Anaconda, Mont., where sulfur dioxide emissions caused a volume loss of 3 million cubic feet of timber on 100,000 acres.

The dwarf mistletoes, *Arceuthobium* spp., are one of the major groups of damaging organisms in the Region.

Most control is accomplished in conjunction with normal timber management activities and is financed from timber funds. A limited amount of control is accomplished by special projects financed by FI&DM. In 1978, FI&DM financed dwarf mistletoe control on



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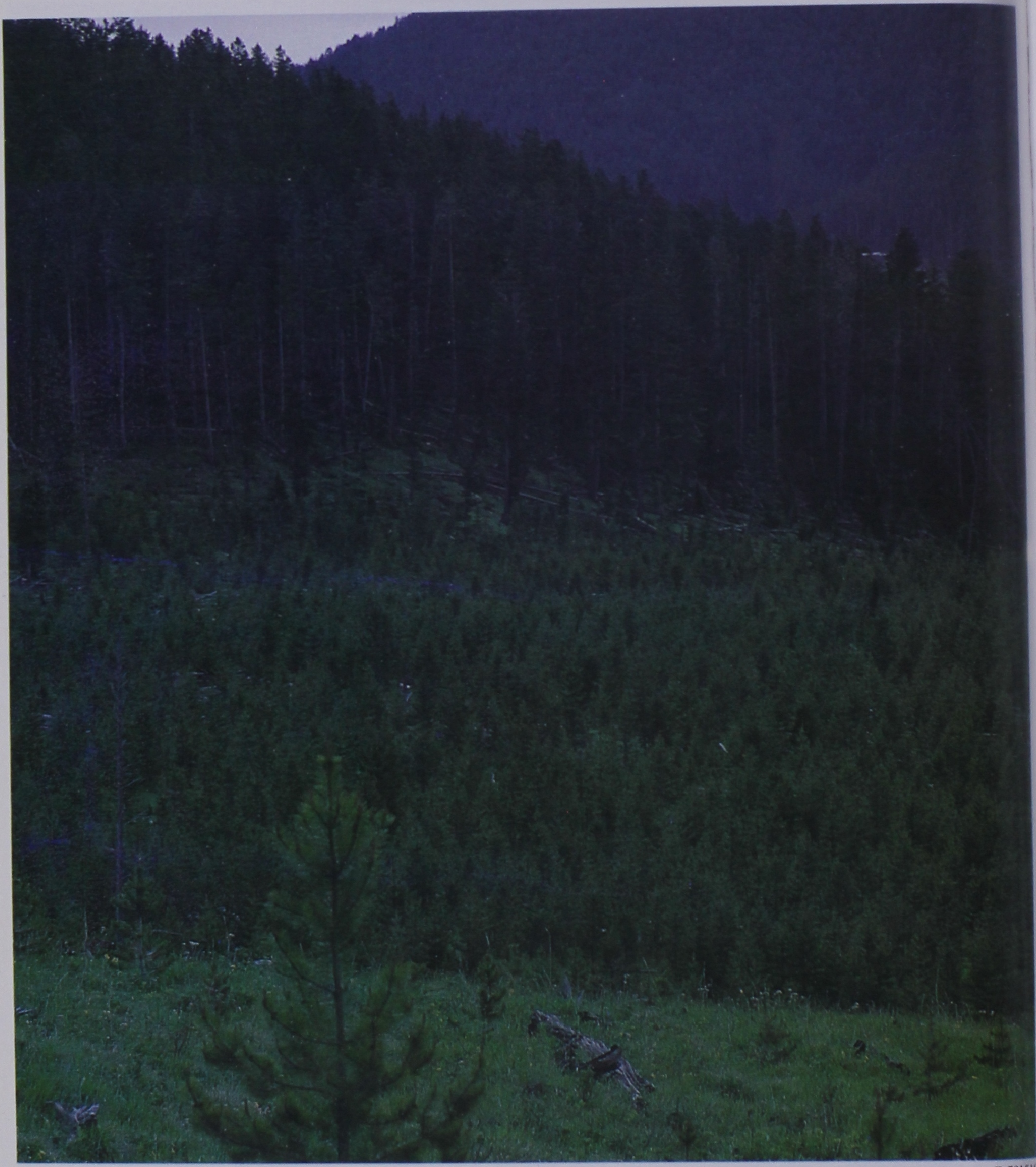
1 *Air pollution.*

2 *Biological technicians record data concerning the impact of fluoride pollution on tree growth. Trees were felled, dissected, and measured for height and diameter increment.*



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Lodgepole pine reproduction sanitation/ thinning for dwarf mistletoe control. Infested overmature stand in background. Gallatin National Forest.

5,700 acres on the Bitterroot, Deerlodge, Flathead, and Lewis and Clark National Forests: Presuppression surveys on 800 acres of the Flathead National Forest, 6,400 acres of the Gallatin National Forest, and 4,000 acres of the Kootenai National Forest.

Arceuthobium americanum Nutt. ex Engelm. was found on lodgepole pine n the Castle Mountains in Meagher County and in the Pryor Mountains in Carbon County, Mont., extending the known distribution of this parasite.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. occurred in scattered locations throughout North Dakota; in Missoula and Ravalli Counties, in western Montana; and in Billings (Yellowstone County) in central Montana. Although this disease was only recently detected in Billings, Mont., it has probably been present for the past 8 to 10 years.

Table 2.—*Estimated annual losses caused by major insects and diseases in Northern Region (in thousand cubic feet)*

Forest area	Dwarf mistletoe	Root disease	Air pollution	Other diseases	Bark beetles	Western spruce budworm
Beaverhead NF	1,291	4,167	—[1]	62	6,881	1112.0
Bitterroot NF	9,747	2,917	—	44	53	3058.0
Idaho Panhandle NFs	18,534	25,000	12,500	375	409	58.6
Clearwater NF	5,918	8,333	—	125	164	81.0
Custer NF	106	208	—	3	—	36.0
Deerlodge NF	2,499	1,953	3,125	29	24	1407.0
Flathead NF	8,179	12,500	875	188	23,291	0
Gallatin NF	502	3,333	—	50	8,928	992.0
Helena NF	813	833	—	12	31	2232.0
Kootenai NF	15,259	10,000	—	150	4,898	0
Lewis & Clark NF	1,538	2,083	—	31	161	735.0
Lolo NF	18,793	5,417	—	81	2,823	1545.0
Nezperce NF	7,107	10,000	—	150	436	38.0
Glacier Nat'l Park	[2]	[2]	[2]	[2]	23,634	[2]
Total	90,286	86,744	16,500	1300	76,733	11,294.6

[1] Dash indicates no measurement made.
[2] Not available.

Other Diseases (R-1)

Disease	Host	Location	Remarks
Didymascella thujina (Durand) Maire	Western redcedar	Idaho Panhandle National Forest, Idaho	Minor defoliation.
Dothistroma pini Hulb.	Ponderosa pine.	Lower Locsha and Priest River Drainage, Idaho	Greater defoliation than previous years.
Lophodermella concolor (Dearn.) Dark.	Lodgepole pine	Idaho and throughout Montana	Serious throughout Montana.
Lophodermella arcuata (Dark.) Dark.	Western white pine	Throughout host type	Locally heavy infection.
Lophodermium nitens Dark.	Western white pine	Throughout host type	Locally heavy infection.
Lecanosticta sp.	Western white pine	Throughout host type	Less severe than 1977.
Napicladium tremulae (Frank) Sacc.	Aspen	Northern Idaho, northwestern Montana	Scattered infection.
Melampsora medusae Thuem.	Aspen	Throughout Idaho and Montana	Heavy infection.

Rocky Mountain Region (R-2)[1]

Robert L. James and James R. Linnane[2]

Forest Insect and Disease Management
State and Private Forestry
Lakewood, Colorado

Conditions in Brief

The mountain pine beetle was the most destructive forest insect pest within the Region, causing substantial losses in ponderosa pine stands in the Colorado Front Range and in the Black Hills of South Dakota and in lodgepole pine and limber pine on the Shoshone National Forest in Wyoming. Suppression projects are underway in Colorado and South Dakota.

The western spruce budworm continued to be a serious defoliator of Douglas-fir and white fir in the Colorado Front Range and to a lesser degree on the San Juan National Forest, Colo., and the Shoshone National Forest, Wyo. Damage from several consecutive years of defoliation was evident, especially in the northern part of the Front Range.

Dwaft mistletoes were the most important diseases in the Rocky Mountain Region. They were especially damaging to lodgepole pine in Colorado and Wyoming and to ponderosa pine in Colorado. Comandra blister rust remained one of the major problems of lodgepole pine in Wyoming.

Important diseases in the Great Plains included: Decline of jack pine in the Nebraska National Forest, heart rot of green ash in shelterbelts, western gall rust in the Black Hills of South Dakota, Cytospora canker of eastern cottonwood in plantations, Dutch elm disease, Diplodia tip blight, and oak wilt. Numerous other diseases of less importance were also reported.

Colorado participated in the Federal Dutch Elm Disease Control Demonstration Project. The State conducted integrated control programs aimed at reducing the number of elms killed by this disease. During 1978, in the four project communities, 296 confirmed cases of Dutch elm disease were reported.

Annosus root rot was found on white fir in southern Colorado. Shoestring root rot and black-stain root disease were common on lodgepole pine reproduction and pinyon, respectively, in Colorado.

Broom rusts of spruce and true fir were found throughout western Colorado. The incidence of the disease varied widely among different stands.

Status of Insects

Mountain Pine Beetle, *Dendroctonus ponderosae* Hopk. This insect continued to kill ponderosa pine in the Front Range of Colorado, the Black Hills of South Dakota, and the Front Range of the Bighorn Mountains of Wyoming. The beetle also caused losses in lodgepole pines and limber pines on the Shoshone National Forest near South Pass City and Atlantic City, Wyo.

In the Colorado Front Range, an estimated 1.5 million trees within 580,000 acres of ponderosa pine died as a result of the current mountain pine beetle epidemic. However, brood surveys indicated a decreasing trend in beetle populations on the Arapaho and Roosevelt National Park and the Pike and San Isabel National Forests.

The mountain pine beetle situation in the Black Hills continued to be serious, with an increasing trend in the northern Black Hills and a static to decreasing trend in the southern Black Hills, Overall results of a buildup ratio survey indicated a 1:0.68 ratio of old to new attacks overall but a 1:2 ratio in the Lead-Deadwood Exemption Area.

Ponderosa pine stands in the Front Range of the Bighorn Mountains suffered losses in scattered groups of 10 to 200 trees with beetle populations showing an increasing trend.

In beetle suppression efforts, the Black Hills National Forest removed 75,590 trees from 77,899 acres and the Shoshone National Forest removed 7,427 trees from 500 acres.

Western Spruce Budworm, *Choristoneura occidentalis* Free. The western spruce budworm remained a serious defoliator in Douglas-fir and white fir stands in Colorado and Wyoming. Over 900,000 acres of forest land exhibited various levels of defoliation in Colorado this year, with most severe damage on the Arapaho and Roosevelt National Forests. These populations are expected to increase slightly next year. Lighter outbreaks occurred on the San Juan National Forest, where populations are declining, and on the Pike National Forest, where populations are increasing. In Wyoming, the Clarks' Fork District of the Shoshone National Forest reported an outbreak.

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[1] Includes National Forests in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming.

[2] The following organizations contributed information for this report: Kansas State University, Cooperative Extension Service; Nebraska State and Extension Forestry; South Dakota Department of Wildlife, Parks and Forestry; Wyoming State Forestry Division; Colorado State Forest Service; and the Rocky Mountain Forest and Range Experiment Station.

Other Insects (R-2)

Insect	Host	Location	Remarks
Western tent caterpillar, *Malacosoma californicum* (Pack.)	Aspen	San Juan, Pike, and San Isabel National Forests, Colo.; near Walsenburg, Colo.	Severe outbreak for 3 years on 8,000 acres, lighter infestations in other areas.
Pine tortrix, *Choristoneura lambertiana ponderosana* Obraztsov.	Ponderosa pine	Pike and San Isabel National Forests, Colo.	Significant defoliation associated with population increase.
Pine tip moths, *Rhyacionia bushnelli* (Busck), *R. frustrana* (Comst.), and *R. neomexicana* (Dyar)	Austrian pine, Loblolly pine	South Dakota and Kansas	Damaging in shelterbelts.
Aspen leafminer, *Phyllocnistis populiella* Chamb.	Aspen	Black Hills, S. Dak.	Severe defoliation.
Western balsam bark beetle, *Dryocoetes confusus* Sw.	True firs	White River and Grand Mesa National Forests and Naval Oil Shale Lands, Colo.	Damaging.
Spruce beetle, *Dendroctonus rufipennis* (Kby.)	Spruce	Regionwide	Endemic.
Bagworms. *Thyridopteryx ephemeraeformis* (Haw.)	Many species	Kansas	Caused mortality in isolated infestations.
Grasshoppers, *Melanoplus* spp.	Many species	Kansas and South Dakota	Damaging on young trees.
Pitch nodule moth, *Petrova metallica* (Busck)	Ponderosa pine	Watertown, S. Dak.	Populations collapsed because of high precipitation.
Sumac sawfly, *Arge coccinea* (F.) and *Coleotechnites* sp.	Sumac	Yankton County, S. Dak.	Severe defoliation; some mortality.
Cottonwood leaf beetle, *Chrysomela scripta* (F.)	Aspen	Black Hills, S. Dak.; Custer and Pierre Counties, S. Dak.	Moderate to heavy defoliation.
Coneworm, *Dioryctria* sp. (possibly *albovitella* complex)	Pinyon	Larimer, Colorado Springs, and Walsenburg areas, Colo.	Damaging.
Pine needle miner, *Coleotechnites* sp.	Ponderosa pine	Colorado Front Range	Damage increasing.

Other Insects (R-2) *(Continued)*

Insect	Host	Location	Remarks
Redheaded ash borer, *Neoclytus acuminatus* (F.)	Green ash	Douglas, Nemaha, Lancaster, and Pawnee Counties, Nebr.	Damaging.
Fall cankerworm, *Alsophila pometaria* (Harr.)	Hackberry, Honeylocust	Hall and Antelope Counties, Nebr.	Heavy infestations.
Zimmerman pine moth, *Dioryctria zimmermani* (Grote)	Pines	Garden, Wayne, and Pierce Counties, Nebr.	Recorded for the first time.
Ash plant bug, *Tropidosteptes amoenus* Reuter	Ash	Saunders and Lancaster Counties, Nebr.	Severe leaf damage in isolated windbreaks.
Greenstriped mapleworms, *Anisota rubicunda* (F.)	Maple	NE. Kans.	Defoliation caused by large populations.

Status of Diseases

The Dwarf Mistletoes, *Arceuthobium* spp., one of the most damaging diseases in the Rocky Mountain Region, were especially severe on lodgepole pine and ponderosa pine. Fifty percent of the commercial lodgepole pine forests in the Region were infested with the parasite *Arceuthobium americanum* Nutt. ex Engelm. The estimated annual volume loss on 743,000 acres on the Bighorn, Shoshone, and Medicine Bow National Forests was 5.4 million cubic feet. On the Red Feather Ranger District, Roosevelt National Forest, Colo., the annual volume loss was estimated to be 684,000 cubic feet on 45,000 acres.

Southwestern dwarf mistletoe (*A. vaginatum* subsp. *Cryptopodum* (Engelm.) Hawks. and Wiens) was important on ponderosa pine in the Front Range of Colorado. About 46 percent of the ponderosa pine in the Front Range is infested.

Limber pine dwarf mistletoe (*A. cyanocarpum* Coulter & Nelson) was found for the first time on whitebark pine in the Wind River Range, Shoshone National Forest. The parasite was common and damaging on both limber pine and whitebark pine.

Stem Diseases

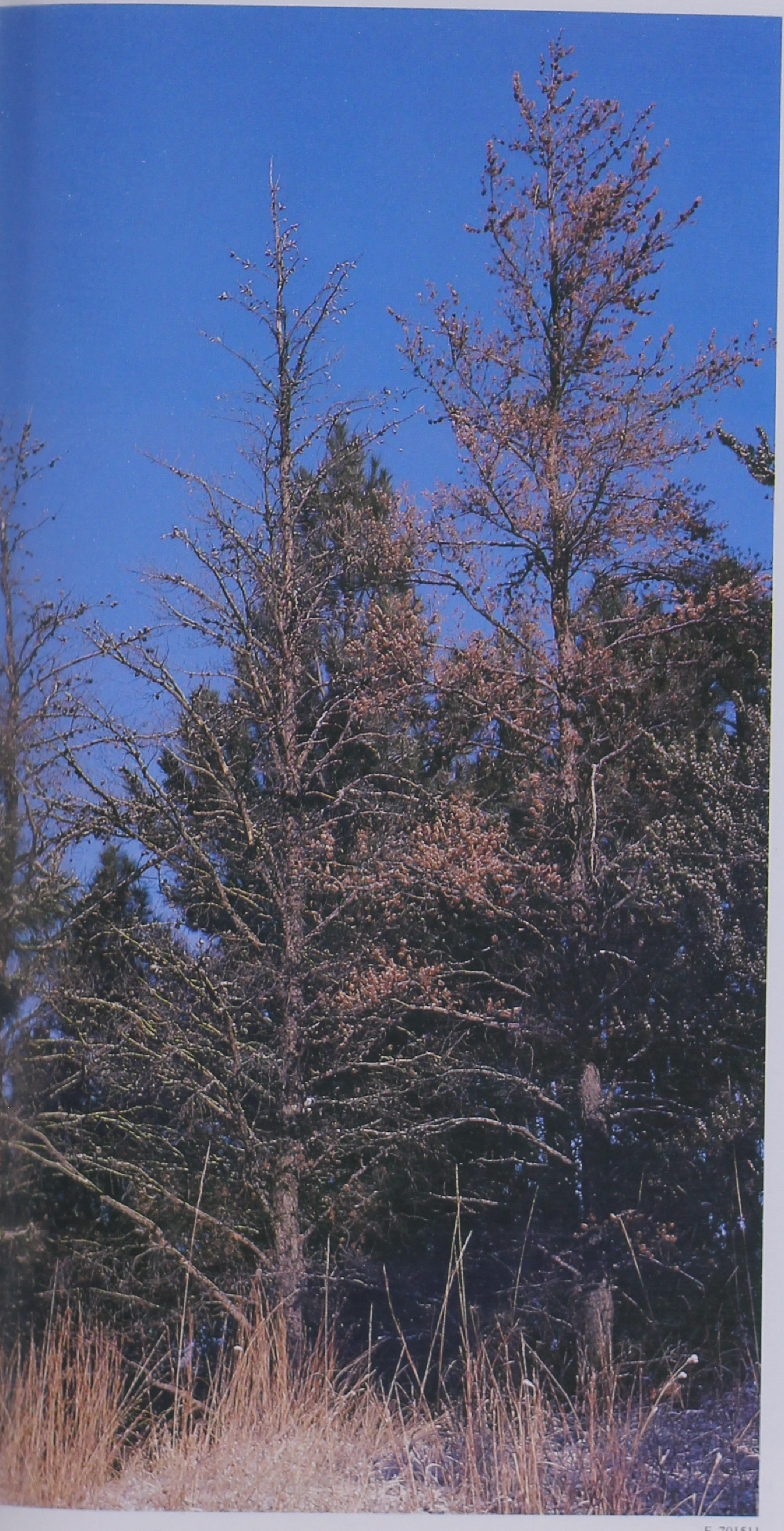
Comandra Blister Rust, *Cronartium comandrae* Peck. This rust continued to pose problems to management of lodgepole pine within the Bighorn, Medicine Bow, and Shoshone National Forests. Losses consist of spike tops, growth reduction, and mortality in pole- to sawtimber-size trees. Acreages of commercial forest infested with this rust range from 80,000 to 90,000 acres on each of these three Forests.

Jack Pine Decline: An unexplained decline of plantation jack pine occurred on the Nebraska National Forest. Symptoms of the disease were found on groups of trees and included chlorotic foliage and reduced needle retention and length. These symptoms were usually not evenly distributed throughout the crown.

Blue stain fungi (primarily *Ceratocystis minor* (Hedg.) Hunt) and numerous insects (*Ips calligraphus* (Germar), *Dendroctonus valens* LeC., *Hylurgops porosus* LeC., *Othius* spp., *Corticeus* spp., and cerambycid wood borers) were associated with the damage. Unknown site factors probably predisposed trees to attack by these insects and fungi. About 16 percent of plantation jack pine trees within the Nebraska National Forest were either dead or displayed symptoms of this malady.

Ash Heartrot, *Fomes fraxinophilus* (Pk.) Sacc. This fungus, a major cause of heartrot in green ash, was widely distributed throughout shelterbelts established from 1935 to 1942. Infected trees were found in 40 counties and in 90 percent of the shelterbelts examined (173 shelterbelts in 41 counties). The fungus was present in all shelterbelts examined in eastern counties with a mean incidence of 6.5 percent; in 96 percent of shelterbelts in central counties with a mean incidence of 5.4 percent; and in 21 percent of shelterbelts in western counties with an incidence of 0.2 percent. Statewide incidence was 5.5 percent.

Western Gall Rust, *Endocronartium*



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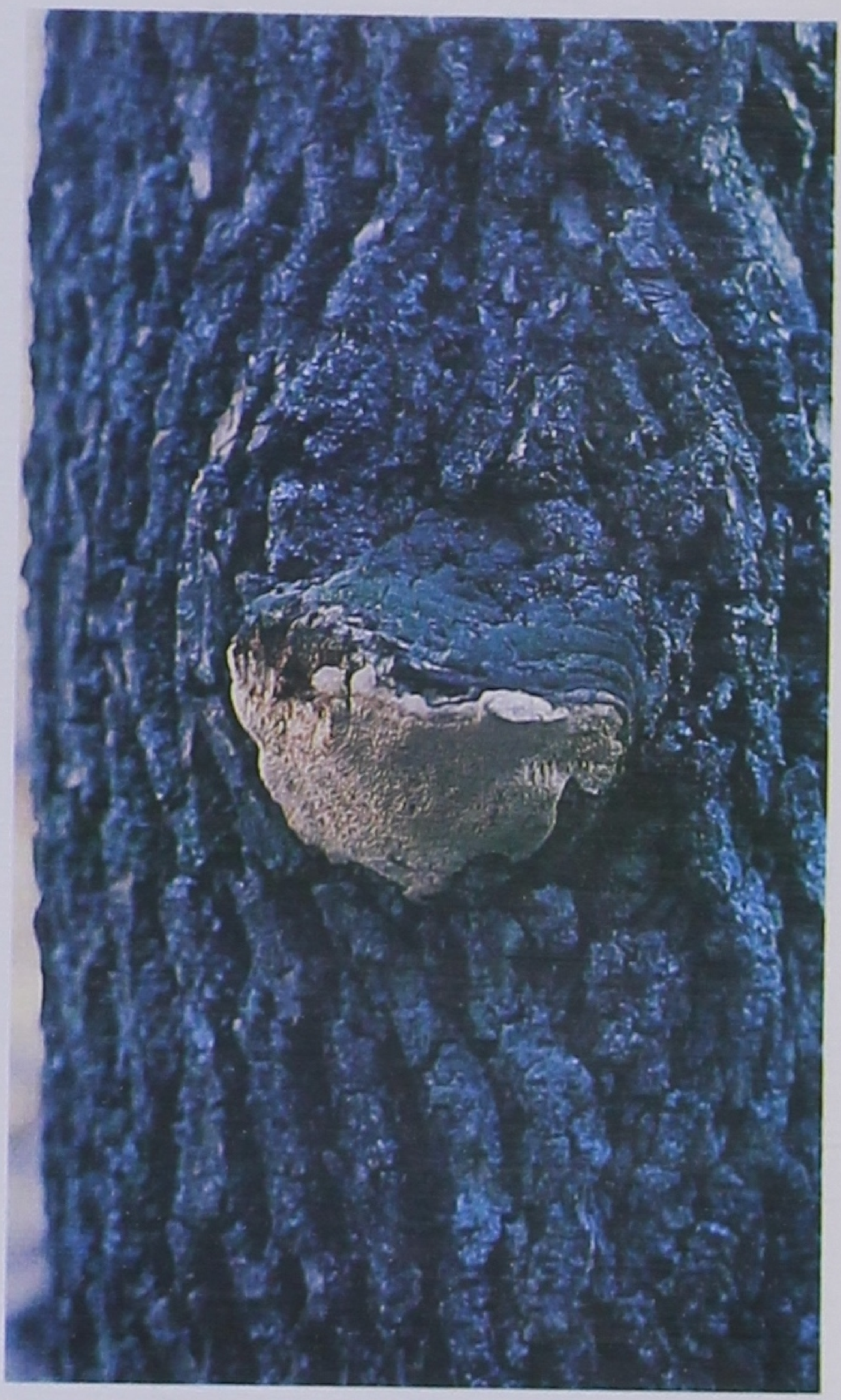

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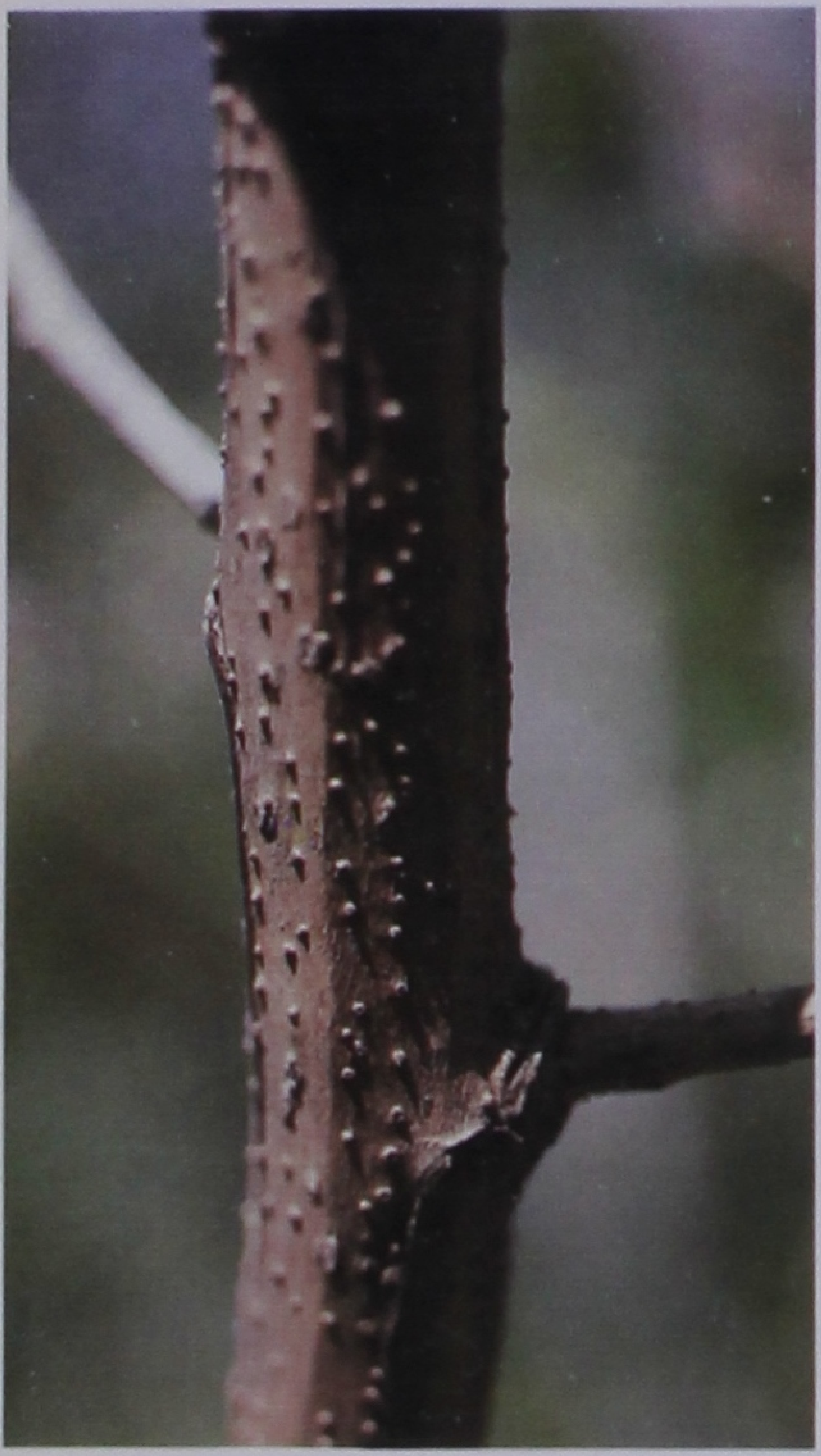
1 *Jackpine decline on the Nebraska National Forest.*

2 *Conk of* Fomes fraxinophilus, *the cause of heart rot in green ash.*



F–701513

Fruiting bodies of Cytospora chrysosperma, *the cause of cytospora canker on eastern cottonwood.*

harknessii (J. P. Moore) Y. Hirat., is an important disease of ponderosa pine in the Black Hills of South Dakota and on the Nebraska National Forest. High infection levels were common in many plantations and young natural stands. Individual tree susceptibility varies. Removal of heavily infected trees during cultural operations is recommended.

Cytospora Canker, *Cytospora chrysosperma* (Pers.) F. Cytospora canker was common on many hardwoods throughout the Region. It was especially damaging on aspen in the Rocky Mountains and on eastern cottonwood in the Great Plains, where it caused dieback of 2- to 3-year-old trees in wood energy plantations in eastern Kansas. Variation of the susceptibility of clones to infection was noted.

Siberian Elm Canker, *Botryodiplodia hypodermia* Sacc. This canker disease was widespread on Siberian elm in shelterbelts and ornamental plantings in South Dakota, Nebraska, and Kansas. Canker-induced mortality was more common in the western portions of these states.

Porcupine Damage. Extensive basal girdling and subsequent mortality in a 35-year-old lodgepole pine plantation near Molas Pass on the San Juan National Forest were noted. Porcupine activity occurred over the past few years and mortality was extensive enough to reduce stocking within certain portions of this plantation.

Sapsucker Damage. Pines were commonly damaged by sapsuckers throughout the Great Plains. In Kansas, sapsucker damage to pines was present in 67 of 68 counties surveyed. The damage was more common on older, less vigorous Austrian and Scots pine than on ponderosa pine. Little mortality resulted from sapsucker damage alone.

Dutch Elm Disease, *Ceratocystis ulmi* (Buism.) C. Mor., Dutch elm disease spread within the western portion of South Dakota, where it was reported in a new county (Pennington), and increased within many cities in western Kansas. Cases reported during the past year indicated an upward trend in losses in certain parts of the state.

Oak Wilt, *Ceratocystis fagacearum* (Bretz)Hunt. No new reports of oak wilt were received in 1978. The disease was endemic in portions of eastern Nebraska and Kansas and occurred in southeastern South Dakota.

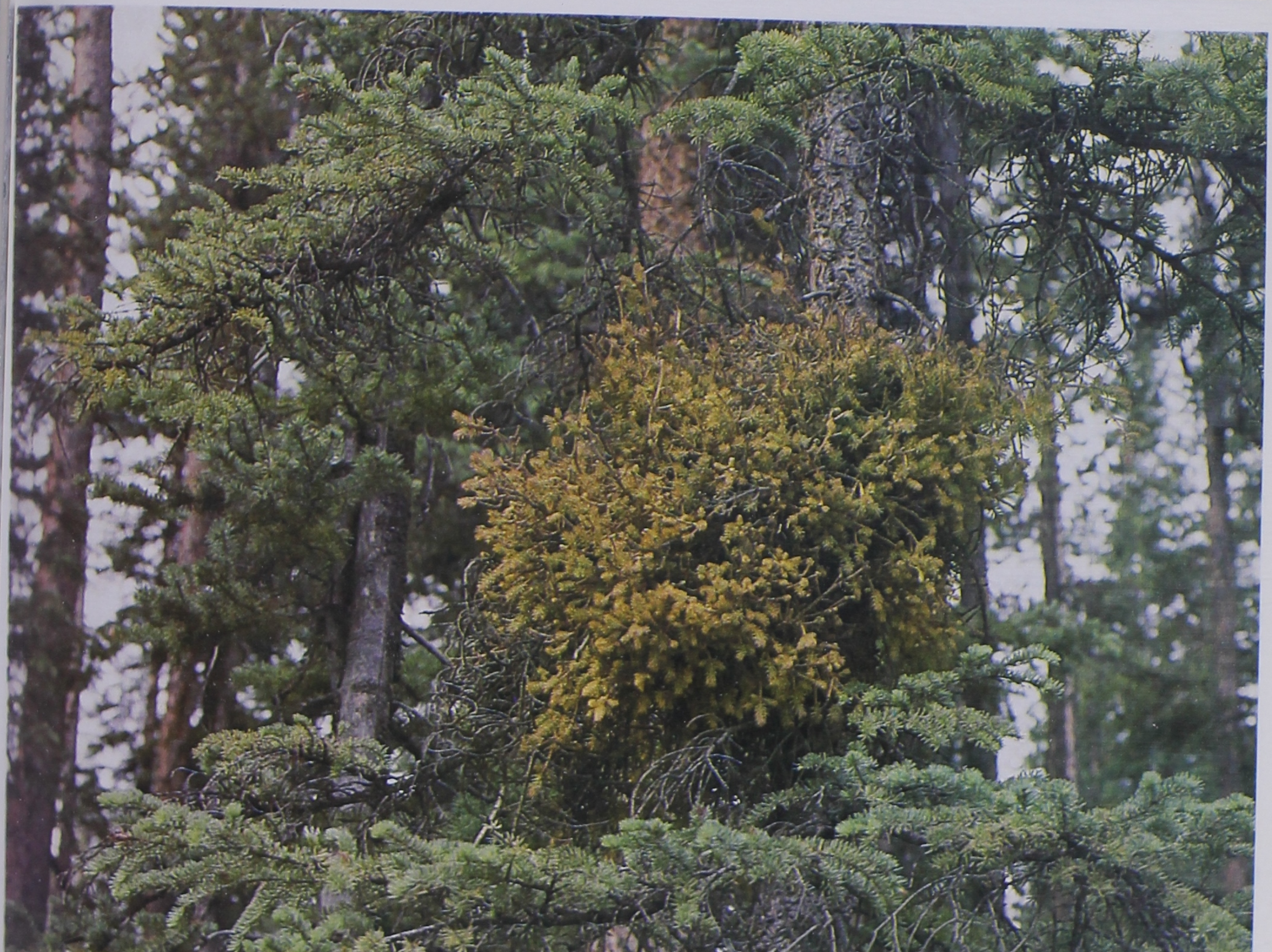
Annosus Root Rot, *Fomitopsis annosa* (Fr.) Karst. Mortality associated with root and butt rot of white fir caused by *F. annosa* was found for the first time in Colorado. Typical infection centers were found within white fir stands on Pike and San Isabel, Rio Grande, and San Juan National Forests in southern Colorado.

Shoestring Root Rot, *Armillariella mellea* (Vahl. ex Fr.) Karst. Shoestring root rot was common on many different host trees throughout the Rocky Mountain Region. Occurrence in lodgepole pine stands less than 25 years old was variable. Infections in stands on the Routt, Grand Mesa-Gunnison and Uncompahgre, and White River National Forests of Colorado ranged from 1.7 to 11.2 percent in young reproduction on cutover sites. Dead trees occurred in groups and were most common adjacent to stumps. *A. mellea* was also associated with western balsam bark beetle (*Dryocoetes confusus*) attacks in subalpine fir on the White River National Forest. In several locations, all bark beetle attacks sampled were also infected with *A. mellea*. Infection by the fungus seemed to be followed by bark beetle attack.

Black-Stain Root Disease, *Verticicladiella wagenerii* Kend. This disease was found on pinyon pine west of the Continental Divide in Colorado. There were 175 active disease centers within 52,000 acres of the Mesa Verde National Park, Colo. Many older centers were also present but mortality had stabilized after a few years. High rates of new infection center establishment suggest continued significant losses. Insects may be vectors of the fungus and play important roles in establishment of new centers. Unlike the situation in California and Oregon, pinyon pine seems to be the only host of *V. wagenerii* in the Rocky Mountain Region.

Spruce and Fir Broom Rusts, *Chrysomyxa arctostaphyli* Diet. and *Melampsorella caryophyllacearum* Schroet. Broom rust of Engelmann spruce (*C. arctostaphyli*) and subalpine fir–white fir (*M. caryophyllacearum*) were commonly found in spruce-fir stands throughout the Rocky Mountains. The highest incidence of spruce broom rust occurred on the Rio Grande National Forest, where up to 45 percent of sawtimber-size trees surveyed were infested. The distribution and incidence of broom rust was widespread and highly variable among stands. Tree mortality was often associated with infections on or near boles of trees. Heavily infected trees were often attacked and subsequently killed by bark beetles. In stands with high infection levels, heavily infected trees should be removed during harvesting or cultural activities.

Diplodia Tip Blight, *Diplodia pinea* (Desm.) Kickx. Incidence of this path-



Witches' broom on Engelmann spruce caused by spruce broom rust.

F–701514

ogen was high and damage severe in several over 30-year-old plantings of Austrian pine in eastern Nebraska. Damage also increased significantly throughout the eastern half of Kansas. In Kansas, trees with heavily infected cones were common in areas where little or no infected shoots existed. Although damage was most common on older Austrian pine, young Austrian, Scots, and ponderosa pines were also infected.

This disease also caused scattered mortality in 2-0 Austrian pine at Bessey Nursery in Nebraska. It was controlled by roguing infected seedlings.

Spruce Needlecast, *Rhizosphaera kalkhoffii* Bub. This needle fungus was found for the first time in native Engelman spruce stands on the Fraser Experimental Forest in Colorado. The pathogen was associated with brooms of apparent genetic origin, but caused little damage.

Abiotic Diseases

Herbicide Damage. Tree damage from herbicide application was widespread throughout the Great Plains, especially in trees near cultivated fields. Especially heavy losses occurred to eastern redcedar in portions of central and eastern Kansas. Indiscriminate and nonregulated application of herbicides often caused significant direct damage as well as predisposing trees to attack by pathogens and insects.

Winter Damage. Winter damage was unusually common on cedars, redbuds, and pines in parts of western Kansas. The damage was so severe in certain areas that dieback of redbud resulted.

Air Pollution Damage. Symptoms on some ponderosa pine foliage near Denver, Colo., resembled oxidant air pollution damage. The symptoms included reduced needle retention and length and needle chlorosis.

Aspen Droop. This widespread and damaging disorder of aspen, characterized by elongated, drooping branches and lack of lateral twigs, was noticed for the past few years in the Colorado Rockies. Death of affected trees will occur in time. Causes of the disease are unknown.

Hardwoods Declines. Declines of hackberry, maple, and oak were common in many parts of the Great Plains.

Nursery Diseases

Shothole Disease, *Coccomyces lutescens* Higg. This disease recently caused severe defoliation of chokecherry seedlings at Bessey Nursery, Nebr. However, the disease was controlled effectively with fungicide applications.

Gray Mold, *Bortytis cinerea* Pers. ex Fr. Gray mold of containerized conifer seedlings in greenhouses continued to cause problems. Adequate spacing and aeration of seedlings was important in reducing losses from *B. cinerea*.

Damping-Off, *Fusarium* spp. and *Phythium* spp. Losses to 1-0 ponderosa pine seedlings were reduced at Mt. Sopris Nursery at Carbondale, Colo., by fumigation with Dowfume® MC-33. Survival was four times greater in fumigated beds than in untreated beds.

Other Diseases (R-2)

Disease	Host	Location	Remarks
Alternaria spp.	Silver maple.	Bessey Nursery, Nebr.	
Bacteria	Cottonwood	Loveland, Colo.	Mortality of cottonwood attributed to bacterial wet wood.
Botryosphaeria spp.	Redbud	Kansas	
Cercospora sequoiae E. & E.	Eastern redcedar	Kansas	
Crytosphaeria (*Libertella*) spp.	Eastern cottonwood.	Bessey Division, Nebraska National Forest	Common on trees near the nursery. Symptoms may be confused with those caused by *Cytospora chrysosperma*.
Dothiora polyspora Shear & David	Aspen.	Colorado	Associated with wounds on aspen sprouts.
Dothiorella spp.	Elm, oak.	Kansas	
Erwinia amylovora (Burr.) Winsl.	Walnut, apple, pear, cherry.	Kansas and Nebraska	

Other Diseases (R-2) *(Continued)*

Disease	Host	Location	Remarks
Fusarium spp.	Eastern redcedar.	Kansas.	
Gnomonia platani Edg.	Sycamore.	Eastern Kansas	Especially damaging on twigs and major branches during May and June.
G. quercina Kleb.	Oak.	Lancaster, Douglas, and Lincoln Counties, Nebr.	
G. ulmea (Schw. ex Fr.) Thuem.	Elm.	Kansas	
Gymnosporangium juniperi–virginianae Schw.	Utah juniper, Eastern redcedar.	Colorado, Nebraska, Kansas	
Marssonia populi (Lib.) Magn.	Aspen, Eastern cottonwood.	Colorado, Kansas	
Mycosphaerella spp.	Ash.	Kansas	
Phoma spp.	Lodgepole pine.	Bessey Nursery, Nebr.	Associated with chlorosis and mortality of 1-0 seedlings.
Phomopsis juniperovora Hahn.	Eastern redcedar.	Kansas	
Phylosticta spp.	Silver maple.	Bessey Nursery, Nebr.	
Physalospora miyabeana Fuku.	Eastern cottonwood, willow.	Kansas	
Phytophthora cactorum (Leb. & Cohn) Schr.	Russian olive.	Fort Collins, Colo.	
Puccinia peridermiospora (Ell. & Tr.) Arth.	Ash.	Saunders and Valley Counties, Nebr.	
Septoria musiva Pk.	Eastern cottonwood.	Nebraska, Kansas	
Taphrina caerulescens (Mont. & Desm.) Tul.	Oak, elm.	Lancaster County, Nebr. and Eastern Kansas	Heavy infections were found throughout many parts of eastern Kansas because of the persistent overcast weather and high innoculum levels.
Venturia populina (Vuill.) Fab.	Eastern cottonwood, willow.	Kansas	
Verticillium albo-atrum Reinke & Berth	Maple.	Wayne County, Nebr.	

Southwestern Region (R-3)[1]

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Forest Insect and Disease Management
State and Private Forestry
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Conditions in Brief

Bark beetle populations remained at low levels, with losses about the same as those reported in 1977. Widely scattered ponderosa pine were killed by mountain pine beetle and western pine beetle throughout the Region. The roundheaded pine beetle caused some ponderosa pine mortality in southern New Mexico. Localized engraver beetle outbreaks occurred in central and southern Arizona. The most significant engraver beetle outbreak occurred on the San Carlos Indian Reservation where logging slash accumulated for several years, allowing populations to build up and attack live trees. An engraver beetle caused heavy mortality in Mexican pinyon in Big Bend National Park, Tex. Small isolated groups of spruce were killed by spruce beetle in some areas.

Activity by major defoliators continued to increase. The number of acres defoliated by Douglas-fir tussock moth in New Mexico increased threefold over the acreages reported in 1977. There were eight separate identifiable infestations. Tussock moth defoliation caused top-kill and mortality to Douglas-fir and white fir. Moderate to heavy defoliation caused by western spruce budworm, primarily on Douglas-fir and white fir, increased from 25,000 to over 50,000 acres. Populations reached high levels on the Kaibab Plateau and Grand Canyon National Park in Arizona and on the Cibola and Carson National Forests in New Mexico.

Dwarf mistletoe continued to cause damage throughout the Region. Southwestern dwarf mistletoe was prevalent on the Lincoln National Forest, N. Mex., and on the Apache-Sitgreaves and Prescott National Forests, Ariz. Use of a revised simulated yield program, RMYLD, that will provide land managers with an estimate of timber volume loss from dwarf mistletoe under various management regimes, was initiated on National Forests in the Region.

Shoestring root rot was found on a large group of dead and declining Gambel oak on the Santa Fe National Forest, N. Mex., and caused mortality in ponderosa pine plantations on the Apache-Sitgreaves National Forest, Ariz. Charcoal root rot was identified on dead ponderosa pine seedlings in plantations on the Kaibab National Forest, Ariz.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. Widely scattered ponderosa pine killed by the mountain pine beetle were detected in northern Arizona and New Mexico. Single faders and groups of 2 to 10 dead trees were observed most commonly. Very few groups exceeding 20 trees were found.

The infestation on the Kaibab National Forest, Ariz., declined to a low level. Activity continued on the adjoining Grand Canyon National Park, but losses were minimal. Mountain pine beetle attacked and killed relatively thrifty trees growing on the best sites in Arizona. No suppession or salvage programs were undertaken.

Overmature, decadent pines growing on poor sites appeared to be preferred by the mountain pine beetle in northern New Mexico. As in 1977, widely scattered tree mortality occurred on the Canjilon, El Rito, Jicarilla, Penasco, Taos, and Tres Piedras Ranger Districts, Carson National Forest; and on the Coyote, Cuba, Espanola, Jemez, Las Vegas, and Pecos Ranger Districts, Santa Fe National Forest. Although dead trees were too scattered to justify salvage, many were used by free use fuelwood cutters. Dead and down trees on these National Forests are an important source of firewood for local residents.

Western pine beetle, *Dendroctonus brevicomis* LeC. Widely scattered trees, singly or in small groups, were killed by this beetle over much of the ponderosa pine type in the Region. Tree losses were about the same as have been detected in recent years on the Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto National Forests, Ariz., and Gila and Lincoln National Forests, N. Mex.

Large diameter trees hit by lightning or weakened by diseases or other factors are preferred by this beetle. Salvage is impractical; however, it has been determined that beetle-killed trees left in the forest make desirable wildlife habitat.

Roundheaded pine beetle, *Dendroctonus adjunctus* Blandf. Scattered ponderosa pine mortality caused by this insect continued near Cloudcroft on the Lincoln National Forest and Mescalero Apache Indian Reservation, N. Mex. The heaviest tree losses were in Five Canyon and Seven Canyon, Mescalero Apache Indian Reservation. Pole-sized trees were attacked most commonly by this insect. Since there are few markets in this area for pole-sized material, opportunities for salvaging infested trees have been limited.

Engraver beetles, *Ips* spp. Ponderosa pine losses due to these bark beetles were considerably less this year than in past years because of adequate and well-spaced rainfall. Thinning and logging slash were created over thousands of acres of pine type in central and southern Arizona, where engraver beetle outbreaks normally occur, but beetles nurtured in the slash failed to cause substantial tree mortality in nearby standing areas. Localized and minor outbreaks occurred on the Pinedale Ranger District, Apache-Sitgreaves National Forest; Flagstaff and Elden Ranger Districts, Coconino National Forest; Chino Valley and Crown King Ranger Districts, Prescott National Forest; and Navajo Indian Reservation, Ariz.

An intense infestation occurred on the San Carlos Indian Reservation in southern Arizona where ponderosa pine logging slash accumulated over a 2½ year period. Arizona five-spined ips, *Ips lecontei* Sw., attacked the slash, completed several generations each year, and reached a high population level in 1978. When no additional slash or weakened pines were available, beetles attacked nearby live trees. Over 60 spots of dead pole- and sawtimber-size trees, some exceeding 400 trees in size, were detected during the 1978 aerial survey. In addition, many green infested trees were found during subsequent ground examinations. Top-killed trees also were common. The Tribe planned to harvest accessible, sawtimber-size trees. The infestation was detected too late for suppression to be a viable alternative.

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[1] Includes forests in Arizona and New Mexico and National Park Service land in western Texas.

In Big Bend National Park, Tex., droughty conditions permitted an engraver beetle, probably *Ips hoppingi* Lan., to increase and cause heavy mortality of Mexican pinyon. Tree losses as high as 40 to 50 percent occurred in portions of Green Gulch. The loss of these trees, which typically occur in sparse stands, adversely affected esthetic values.

Spruce beetle, *Dendroctonus rufipennis* (Kby.) Small isolated groups of spruce beetle-killed trees were detected throughout the Region from aerial surveys. Tree mortality was found on the Lincoln and Santa Fe National Forests, N. Mex., and the Coconino National Forest and Fort Apache Indian Reservation, Ariz.

Western spruce budworm, *Choristoneura occidentalis* Free. Defoliation caused by this insect decreased from 197,788 acres in 1977 to 78,535 acres in 1978. There was a twofold increase in defoliation in the moderate to heavy classes from 1977 (25,796 acres) to 1978 (51,494 acres). Budworm populations reached high levels on the Kaibab Plateau, Kaibab National Forest, and Grand Canyon National Park, Ariz., and the Montainair Ranger District, Cibola National Forest; the Questa and Taos Ranger Districts, Carson National Forest; and the Taos Pueblo Indian Reservation, N. Mex. Egg mass surveys indicate an increasing infestation trend with moderate to heavy defoliation in 1979 on these areas.

Sampling continued on the western spruce budworm suppression evaluation project, Jemez Mountains, N. Mex. Larval populations were 0.9 larva per 100 buds in an area treated in 1977. Larval populations dropped 18 percent in the untreated area to 8.7 larvae per 100 buds.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). In New Mexico, the tussock moth defoliated 7,000 acres of forested land—a threefold increase from 1977. There were eight separate infestions ranging in size from 300 to 2,500 acres and in age from 1 to 4 years. All infestations occurred in the mixed conifer type in steep-sided drainages. In each outbreak, the defoliation caused top-kill and tree mortality to Douglas-fir and white fir. A new outbreak of 1,000 acres of heavy defoliation was found in Bear Canyon on the west side of the Sandia Mountains on private land within the Cibola National Forest, N. Mex. Survey results indicated a continued increase in the intensity and severity of the outbreaks for 1979. Several canyon infestations had the potential to spread into larger susceptible stands. In all infestations, heavy tree mortality could occur over the next 3 to 4 years. In New Mexico, tussock moth infestations are known to persist up to 10 years.

A pilot project in Los Alamos, N. Mex., tested the operational effectiveness of using a nucleopolyhedrosis virus to control the tussock moth. The virus was aerially applied to 1,300 acres located within Los Alamos and Pueblo Canyons. Over 1,900 ornamental trees were treated with a ground application of carbaryl. Both the virus and the chemical insecticide treatments caused more than 95 percent larval mortality. However, the infestation is expected to continue in the Los Alamos area, since there are several pockets of defoliation located outside the treatment area.

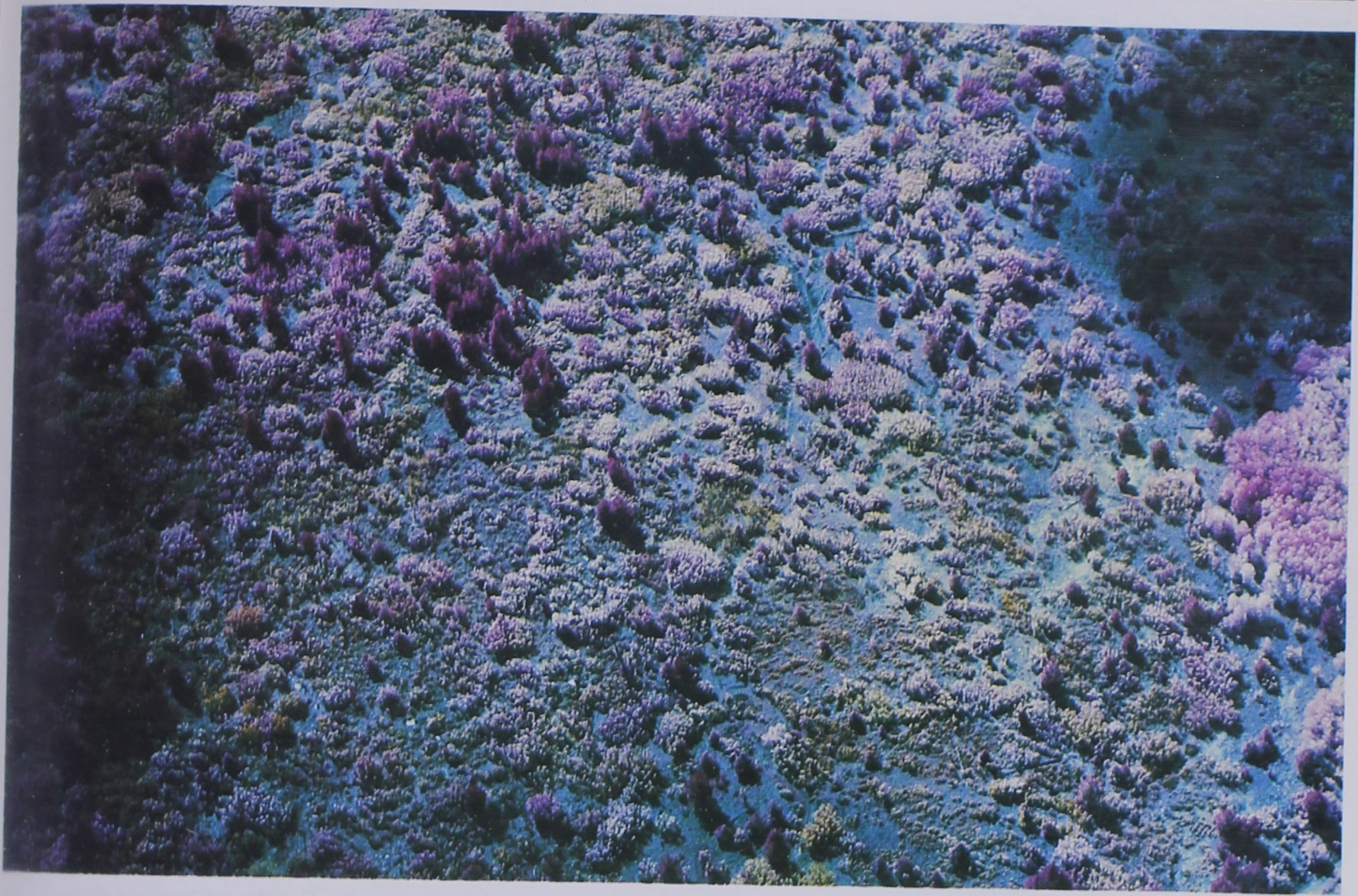
In Arizona, Douglas-fir tussock moth infestations remained at a low level. Surveys conducted near Aztec Peak, Pleasant Valley Ranger District, and Pinal Peak, Globe Ranger District, Tonto National Forest, showed less than one larvae per 1,000 square inches of foliage. Populations levels are expected to remain low in 1979.

Other Insects (R-3)

Insect	Host	Location	Remarks
Alder flea beetle, *Altica ambiens* LeC.	Arizona alder	Prescott National Forest, Ariz.	
Coneworms, *Dioryctria* sp. and *Rhyacionia neomexicana* (Dyar.)	Ponderosa pine	Coconino National Forest, Ariz.; Lincoln National Forest, N. Mex.	
Fir engraver, *Scolytus ventralis* LeC.	Douglas-fir True fir	Arizona and New Mexico	Scattered throughout.
Pine seed chalcid, *Megastigmus albifrons* Walk.	Ponderosa pine	Kaibab National Forest, Ariz.	

Other Insects (R-3) *(Continued)*

Insect	Host	Location	Remarks
Pinon ips, *Ips confusus* (LeC.)	Pinyon	Arizona and New Mexico	Scattered throughout.
Pinon needle scale, *Matsucoccus acalyptus* Herb.	Pinyon Single leaf pinyon	Arizona and New Mexico	Scattered.
Pinon pitch nodule moth, *Petrova albicapitana arizonensis* (Hein.)	Pinyon	Arizona and New Mexico	Twig damage on ornamentals.
Pinon sawfly, *Neodiprion endulicolus* Ross	Pinyon	Cibola National Forest, N. Mex.	
Ponderosa pine cone beetle, *Conopthorus ponderosae* Hopk.	Ponderosa pine	Kaibab National Forest, Ariz.; Jicarilla Apache Indian Reservation, N. Mex.	
Ponderosa pine seed moth, *Laspeyresia piperana* (Kear.)	Ponderosa pine	Kaibab National Forest, Ariz.; Bandelier National Monument and Lincoln National Forest, N. Mex.	
Western tent caterpillar *Malacosoma californicum* Pack.	Aspen	Santa Fe, Cibola, and Carson National Forests, and Bandelier National Monument, N. Mex.	Medium to heavy defoliation and branch mortality.
New Mexico fir looper, *Galenara consimilis* Hein.	Douglas-fir White fir	Lincoln National Forest, N. Mex.	90% trees defoliated in 1977 have died.
Scarab, *Phyllophaga* sp.	Ponderosa pine	Gila National Forest, N. Mex.	7,000 acres defoliated.
Prescot scale, *Matsucoccus vexillorum* Morr.	Ponderosa pine	William, Ariz.; Los Alamos, N. Mex.	
Southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar)	Ponderosa pine	Apache-Sitgreaves, Coconino, and Kaibab National Forests, Ariz.	
Tiger moth, *Halisidota ingens* Hy. Edw.	Ponderosa pine	Arizona and New Mexico	Scattered throughout.



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Aerial color infra-red photograph showing shoestring root rot center in Gambel oak. Dead and dying oaks form the small, circular, brownish-yellow patch in the center.

Status of Diseases

Dwarf mistletoe, *Arceuthobium* spp. Losses from southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. & Wiens, on ponderosa pine were most prevalent on the Apache-Sitgreaves, Lincoln, and Prescott National Forests. Mortality was scattered throughout all forests. On the Apache-Sitgreaves National Forest, spittlebugs (*Clastroptera distincta* Doer.) were again noted feeding on dwarf mistletoe, causing some mortality of aerial shoots. Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., was common in mixed conifer stands in the southern half of New Mexico and Arizona, and on the Carson National Forest, N. Mex. Other species causing timber losses were *A. apachecum* Hawks. & Wiens on southwestern white pine and *A. microcarpum* (Engelm.) Hawks. & Wiens on Engelmann spruce.

Data gathered from surveys conducted over the last 4 years in mistletoe-infected ponderosa pine stands are being processed by the RMYLD program to provide a new, more accurate estimate of timber volume loss for the Region.

Shoestring root rot, *Armillariella mellea* (Vahl. ex Fr.) Karst. Dead and declining Gambel oak on the Sante Fe National Forest, N. Mex., was infected with shoestring root rot. This fungus also caused mortality in ponderosa pine plantations on the Apache-Sitgreaves National Forest, Ariz., and is at endemic levels throughout the Region.

Charcoal root rot, *Macrophomina phaseoli* (Maub.) Ashby. This disease was identified on dead ponderosa pine seedlngs in plantations on the Kaibab National Forest, Ariz. Primarily a nursery disease, charcoal root rot can cause mortality if infected seedlings are stressed in outplanting. Proper nursery fumigation can reduce losses to this disease.

Fir broom rust, *Melampsorella car-*

yophyllacearum Schroet. Damage by fir broom rust is variable. This rust is of minor importance in the Carson National Forest, N. Mex., but it may be significant on the Cibola National Forest, N. Mex.

Trunk rot, *Echinodontium tinctorium* (E. & E.) E. & E. This disease was found on white fir and Douglas-fir in overmature stands on the Apache-Sitgreaves and Kaibab National Forests, Ariz., and on the Carson and Cibola National Forests, N. Mex. Infected white fir trees were also found in campgrounds on the Cibola National Forest.

The status of other trunk rots in the Region remained the same—present, but not important.

Nursery diseases. Mortality in ponderosa pine seedlings from the Bureau of Indian Affairs greenhouse at Dulce, N. Mex., was related to various species of damping-off fungi while losses at the McNary, Ariz., nursery were caused by improper irrigation and lack of nutrients. One-year-old ponderosa pine seedlings at the Albuquerque Tree Nursery were stunted and discolored because of high pH and nutrient inavailability. An acid injection system has been installed in the irrigation system in an attempt to correct the problem. Containerized ponderosa pine seedlings, also in the Albuquerque Nursery, showed tipburn and mottling of needles characteristic of air pollution damage. Seedlings on the Lincoln National Forest, N. Mex., suffered reduced vigor and some mortality caused by several species of fungi.

Salt damage. Heavy applications of road salt caused considerable mortality or aspen, ponderosa pine, Engelmann spruce, white and cork bark, firs and Douglas-fir in several areas of New Mexico. All trees were located on the downslope side of the road within 25 feet of the roadside.

Weather. Snow-bending of ponderosa pine saplings, caused by late snowfalls, was reported from various forest in the Region. This could result in future volume loss from deformed trees.

Numerous lightning-struck trees, often those left as seed tree, were observed in central and northern Arizona on the Apache-Sitgreaves, Coconino, and Kaibab National Forests. These trees were often the target of secondary insect infestations.

Drought was not a serious factor in the Southwest in 1978.

Animal damage. Rodent damage to ponderosa pine was found on several plantations on the Santa Fe National Forest. Trees were either girdled or cut off at the base. Porcupine damage to ponderosa pine was seen on several areas on the Carson National Forest. Elk ''barking'' of aspen was also common on both the Carson and Santa Fe National Forests.

Other Diseases (R-3)

Disease	Host	Location	Remarks
Elytroderma deformans (Weir.) Dark.	Ponderosa pine	Navajo Army Depot, Ariz.	Scattered throughout Region.
Linula abietinus-concoloris (Mayr. ex Dearn.) Dark.	White fir	Arizona and New Mexico	Scattered.
Rhabdocline pseudotsugae Syd.	Douglas-fir	Arizona and New Mexico	Scattered.
Gymnosporangium ssp.	Juniper	Cibola National Forest, N. Mex.	Scattered.
Lophodermella cerina (Dark.) Dark.	Ponderosa pine	Gila, National Forest, N. Mex.	Scattered.
Spruce broom rust, *Chrysomyxa arctostaphyli* Diet.	Engelmann spruce	Arizona and New Mexico. Carson National Forest, N. Mex.	Scattered. Large pockets.
Limb rust, *Peridermium filamentosum* Pk.	Ponderosa pine	Coconino and Kaibab National Forests, Ariz., Santa Fe National Forest, N. Mex.	Scattered; branch and limited tree mortality; significant damage when in seed trees.

Intermountain Region (R-4)[1]

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Conditions in Brief

Bark beetles were once again the primary cause of tree mortality in the Intermountain Region in 1978. Mountain pine beetle activity in lodgepole pine increased on the Boise and Payette National Forests, Idaho. Populations stabilized on the Caribou National Forest, Idaho, and Ashley National Forest, Utah. Infestations decreased on the Targhee National Forest, Idaho, and Bridger-Teton National Forest, Wyo.

Douglas-fir beetle-caused tree mortality was about the same as in 1977. However, there was a slight fluctuation in local infestations throughout the Region. Douglas-fir mortality on the Payette National Forest diminished in severity, whereas mortality on the Salmon National Forest, Idaho remained static.

Pine engraver beetle activity on the Boise National Forest expanded and intensified in 1978. The number of mortality centers on the Payette National Forest increased slightly; however, decreases were noted in some areas. The rapid increase that started in 1977 seems to have peaked.

The first male gypsy moth to be collected in the Intermountain West was caught in a pheromone trap at Zion National Park, Utah, in 1978.

Western spruce budworm defoliation increased to 1.5 million acres on six National Forests—the Bridger-Teton, Boise, Targhee, Salmon, Caribou, and Challis—and in the Idaho Primitive Area and Grand Teton National Park. However, defoliation on the Payette National Forest decreased.

The dwarf mistletoes are still considered to be the most destructive pathogens in Intermountain Region Forests.

Needlecast diseases and drought were the most noticeable diseases but neither caused significant losses.

Dutch elm disease still has not been found in Utah or Nevada.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. The western spruce budworm infestation increased from slightly less than 1 million acres in 1977 to about 1.5 million acres in 1978. The largest increases occurred on the Bridger-Teton, Boise, Caribou, Targhee, and Salmon National Forests.

The Bridger-Teton National Forest suffered defoliation by western spruce budworm at a level above that in 1976, following a 1977 decrease. The total defoliated area reached 199,600 acres. Major expansions occurred in the Mosquito, Fall, upper Willow, and lower Granite Creek drainages.

On the Boise National Forest, defoliation by budworm intensified and expanded from 132,100 acres in 1977 to 228,000 acres in 1978. Heavy defoliation extended throughout the host type near Sagehen Reservoir, Emmett Ranger District, and in the Eagle Nest Mountain area on the Cascade Ranger District.

Significant increases in budworm defoliation also occurred on the Targhee and Caribou National Forests. These two Forests had light to heavy defoliation on 90,000 acres for the first time in recent years. New outbreaks on the Targhee occurred along the east side of the Big Hole Mountains. The Caribou outbreak occurred along the east side of the Caribou Range, except for a small area of defoliation in Smith Canyon.

The 1978 infestations on the Salmon National Forest, Idaho, occurred in the same general areas as in 1977. An increase in defoliation intensity was noted in the Panther Creek and the North Fork of the Salmon River drainages. New areas also were found in the Silver Creek drainage and in the Yellowstone Creek and Shovel Creek areas on the southern part of the Forest (183,200 acres in 1978).

In 1977, a new 500-acre infestation center was discovered on Blacktail Butte in Grand Teton National Park, Wyo., on lands adjacent to the Bridger-Teton National Forest. New centers of defoliation developed to the north and west of Blacktail Butte in 1978. This defoliation located between Phelps Lake and Leigh Lake along the base of the Teton Mountains, was visible to Park visitors. The largest area of new defoliation is in the lower Pilgrim Creek drainage.

Defoliation on the Payette National Forest decreased in the Boulder Creek drainage, west of the South Fork of the Salmon River. An increase in extent and severity of defoliation was noted in the Weiser River drainage on the Council Ranger District.

In the Idaho Primitive Area, which includes portions of four National Forests, the budworm infestation increased from 291,000 acres in 1977 to 338,400 acres in 1978.

A proposal to spray the western spruce budworm infestation on the Boise and Payette National Forests in 1978 was evaluated and an environmental impact statement was written. The decision was to postpone treatment until additional impact information could be obtained and analyzed.

Gypsy moth, *Lymantria dispar* (L.). In cooperation with the Animal and Plant Health Inspection Service, the Forest Service has conducted a detection survey for the gypsy moth in parts of southern Utah for several years. Pheromone-baited traps were placed in major tourist areas where suitable host trees were abundant. Areas close to major east-west tourist travel routes were selected for trapping. A male gypsy moth was trapped in Zion National Park, Utah, in 1978. This was the first collection of this insect in the Intermountain West. The survey is being expanded to determine if gypsy moth has become established in Zion National Park and to assess the need for possible control action. Occasional occurrences of exotic insects do not necessarily mean that the species has become established.

Larch casebearer, *Coleophora laricella* (Hbn.). About 500 acres of defoliation by the larch casebearer were detected during an early June aerial survey in the Elkhorn Creek drainage on the

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[1] Includes forests in Arizona and New Mexico and National Park Service land in western Texas.

Payette National Forest. An imported parasitic wasp, *Agathis pumila* (Ratz.), was collected in northern Idaho in cooperation with the Idaho Department of Lands and released in casebearer-infested larch stands on the Payette and Boise National Forests, State, and private lands in Idaho. Previously, the wasp was not known to occur south of the Salmon River.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The trend of most mountain pine beetle infestations in Region 4 is static to decreasing. The Targhee and Bridger-Teton National Forests experienced a decrease in tree mortality. Contrary to the Regional trend, the Boise and Payette National Forests had increased tree mortality.

Increases in pine mortality caused by the mountain pine beetle on the Payette National Forest were observed as an expansion of the infestations around Lost Valley Reservoir, Payette Lake, Johnson Creek, and Paddy Flat, where about 28,000 trees were killed.

Over 23,000 recently killed lodgepole pines were observed on the Boise National Forest. New infestations were noted north and east of Deadwood Reservoir (about 10,000 lodgepole pines) and east of Smith's Ferry (about 4,000 lodgepole and ponderosa pines). Many of last year's outbreak centers expanded in size.

Chronic infestations of mountain pine beetle continued at about the same level as noted in 1977 in the Warm Springs and Big Wood River drainages, Ketchum Ranger District, Sawtooth National Forest. Mountain pine beetle activity continued to decline on the Twin Falls Ranger District. Intensive ground surveys showed that tree mortality decreased from 10,000 trees in 1977 to 8,000 trees in 1978.

On the Caribou and Ashley National Forests, tree mortality was nearly static. Major centers on the Caribou National Forest were found in the Crow, Georgetown, Stump, Tincup, and McCoy Creek drainages. Most of the current mortality on the Ashley National Forest occurred in Alma Taylor Hollow, Taylor Mountain, Big Lake, Greendale Junction, and Carter Creek.

The massive infestation of mountain pine beetle on the Targhee National Forest continued to decline in 1978. The annual mortality steadily decreased from a high of 35 trees per acre in 1976 to 19 trees per acre in 1977 and a current loss of 13.5 trees per acre. The accumulative loss since 1975 is 128 trees per acre, representing the highest mortality caused by the mountain pine beetle in Region 4 during the last 30 years. The only exception to the overall decline was found along the northwest side of the Teton Basin Ranger District, where mortality increased in stands along the forest fringe.

On the Bridger-Teton National Forest, losses continued to decline, with only minor active infestations remaining.

Ponderosa pines killed by the mountain pine beetle occurred in localized areas on the Boise and Payette National Forests in Idaho and on the Dixie National Forest in Utah.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. The Douglas-fir beetle killed many Douglas-firs over much of the Boise National Forest in 1978. Mortality continued along the South Fork of the Payette River from Lowman to Grandjean and along the North and Middle Forks of the Boise River. Expanded mortality occurred along Clear Creek near Lowman and within the Silver Creek drainage east of Boiling Springs. Centers of Douglas-fir beetle-caused mortality persisted in the areas between Mores Creek and the Boise River westward, and from the North Fork of the Boise River south and eastward.

The Douglas-fir beetle was the only abundant bark beetle encountered on the Salmon National Forest. Douglas-fir mortality in the Panther Creek drainage and near North Fork, Idaho, was the last vestige of the epidemic which began 5 years ago.

Renewed tree killing occurred in Grand Teton National Park along the base of the Teton Mountains between Teton Village and Leigh Lake. The dead trees were visible from many of the scenic turnouts throughout the Park.

Pine engraver, *Ips pini* (Say). Older *Ips* infestations in Boise National Forest ponderosa pine stands intensified and several new outbreaks developed, especially on the west side of the Forest. Large groups of faded ponderosa pine were observed along Dry Buck Creek, west of Banks, and along the eastern shore of Cascade Reservoir. On the east side of the Forest, new outbreaks of *Ips* were scattered, with a heavy infestation continuing along Trail, Little Rattlesnake, and Rattlesnake Creeks.

On the Payette National Forest, about 6,000 ponderosa pines were attacked in 183 infestation centers. New groups were recorded along the Salmon River near Studebaker Saddle and the Fingers. Increases were also noted in the area west of Council along Hornet Ridge. Outbreaks south of Lost Valley Reservoir and along the Little Salmon River reported last year declined in 1978.

Western pine beetle, *Dendroctonus brevicomis* LeC. Western pine beetle outbreaks were minor in 1978. Twenty small groups of faders were scattered on the Boise National Forest. On the Payette National Forest, 23 groups of dead trees were found in three areas: Bear Wallow, Freight Landing, and south of Hornet Ranger Station.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. Mortality in jeffrey pine on the Toiyabe National Forest, Nev., and on adjacent State and private lands in Nevada and California has increased slowly since 1975. Widely scattered tree killing occurred throughout the pine type from Mount Ina Coolbrith, northwest of Reno, south to Bridgeport, Calif. Group killing occurred in the southwest corner of Dog Valley in the Winter Creek drainage near Washoe City along the east side of Tahoe Basin from China Garden to Lincoln Park, and in several locations in the vicinity of Markleeville, Calif.

Increases in insect-associated tree mortality during the last 4 years is thought to be, in part, a result of extreme drought conditions which occurred from 1974 to 1977. Most of this mortality occurred in areas that are marginally productive because of rocky, coarse-textured, or thin soils, which have a low moisture holding capacity.

Other Insects (R-4)

Insect	Host	Location	Remarks
White fir needle miner *Epinotia meritana* Hein.	White fir	Dixie National Forest, Utah	Light to heavy defoliation on about 3,000 acres.
Ponderosa pine needle miner *Coleotechnites* sp.	Ponderosa pine	Salmon, Boise, and Payette National Forests, Idaho	Expanded and new infestations.
Fall cankerworm *Alsophila pometaria* (Harr.)	Box elder, cottonwood	Fishlake National Forest, Utah	Moderate to heavy defoliation.
Tiger moth *Halisidota ingens* Hy. Edw.	Ponderosa pine	Manti-LaSal National Forest, Colo.	Defoliation and some top killing.
Sawfly *Neodiprion fulviceps* Cresson	Ponderosa pine	Fishlake National Forest, Utah	Heavy defoliation and light branch mortality.
Sawfly *Neodiprion* sp.	Ponderosa pine	Boise National Forest, Idaho	Damaging buds and needles.
Leafroller *Archips negundanus* (Dyar)	Box elder	Wasatch Front, Ogden, and Uinta National Forest, Utah	Continuing defoliation
Western tussock moth *Orgyia cana* (Edw.)	Ceanothus and other shrubs	Idaho City and Centerville, Utah	Defoliated 3,200 acres.
Douglas-fir tussock moth *Orgyia pseudotsugata* (McD.)	Blue spruce	Boise, Idaho	Found on one tree.
Black pineleaf scale *Nuculaspis californica* (Cole.)	Ponderosa pine	Genoa, Nev.	Declining population on 400 acres.
Western balsam bark beetle *Dryocoetes confusus* Sw.	Subalpine fir	Utah, Wyoming, and SE. Idaho	Tree mortality increasing.

Status of Diseases

Dwarf Mistletoe, *Arceuthobium* spp. A regionwide survey was conducted to assess the incidence of and the cubic-foot volume losses from lodgepole pine dwarf mistletoe (*A. americanum* Nutt. ex Engelm.) and ponderosa pine dwarf mistletoe (*A. campylopodum* Engelm. and *A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawks. & Wiens). Douglas-fir stands were also surveyed for dwarf mistletoe (*A. douglasii* Engelm.) for future analysis with proposed Douglas-fir yield simulation models. The survey consisted of two parts—a roadside rating and plot inspections. About 3,500 miles of roads within 13 Forests were surveyed, with temporary plots established every 3 miles.

The effects of lodgepole pine dwarf mistletoe are summarized in Table 3.

A presuppression survey on the Payette National Forest was conducted to evaluate proper dwarf mistletoe control on 150 new and old clearcut areas. The initial results indicate satisfactory dwarf mistletoe control through normal silvicultural procedures.

Forest Insect and Disease Management surveys and funding were also provided in 1978 to support dwarf mistletoe control projects on five National Forests. A total of 4,530 acreas of forested land was protected from future mistletoe infection through sanitation and overstory removal projects.

Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor. Contingency plans

F–701516

Lack of nutrient availability, a result of high soil pH, caused 1-0 ponderosa pine seedlings to become discolored and stunted at the Albuquerque Tree Nursery.

were drafted and submitted to the States of Utah and Nevada, as these States currently do not harbor the wilt fungus. Several assistance calls were made during the field season to examine trees thought to have the disease, but laboratory and field studies did not corroborate any new areas of infection. The State of Utah is completing an inventory of street tree species.

Drought damage. The drought of 1975-77 was responsible for some tree decline and mortality on poor sites. Dead and dying Jeffery and ponderosa pine were found concentrated in a 500-acre area west of Washoe Valley, Nev. The area is located at the base of a mountain range where the pine forest gives way to sagebrush dominated rangeland. Symptoms associated with the drought stress included wilted and faded needles on the dying trees, which was more pronounced on the south side of the tree. Mortality was most severe in those trees that bordered a stand, particularly on the south-facing slopes. No primary pathogens or insects were found. Therefore, it is believed that the observed mortality was a result of extreme water stress caused by a depletion of ground water that occurred during periods of subnormal precipitation.

Table 3.—*Incidence and cubic foot volume loss from dwarf mistletoe on lodgepole pine forests in Region 4 (Information based on 1978 plot surveys and the RMYLD simulation model)*

National Forest*	Lodgepole pine plots with dwarf mistletoe	Annual volume lost from dwarf mistletoe
	Percent	Cubic feet
Ashley	58	3,304,445
Boise	57	1,598,052
Bridger-Teton	67	3,195,936
Caribou	68	2,290,318
Payette	50	1,460,868
Salmon	59	4,965,080
Sawtooth	71	3,798,757
Targhee	79	6,066,900
Wasatch	34	1,600,066
TOTAL		28,280,432

* The Humboldt, Toiyabe, Fishlake, Dixie, Manti-LaSal, and Unita National Forests have little or no forest acreage in the lodgepole pine type and thus are excluded from this table.

Dwarf-mistletoe-infected lodgepole pine spreads infection to understory trees.

F–701517

Other Diseases (R-4)

Disease	Host	Location	Remarks
Lodgepole pine needlecast *Lophodermella concolor* (Dearn.) Dark.	Lodgepole pine	Payette, Boise, Challis, and Salmon National Forests, Idaho	Widespread; some mortality of seedlings and saplings in areas of heavy infection.
Elytroderma needleblight *Elytroderma deformans* (Weir.) Dark.	Ponderosa pine	Payette and Boise National Forests, Idaho	Scattered; heavy in local areas.
Greybeard *Lophodermium* sp.	Ponderosa pine	Boise and Idaho City Ranger Districts, Boise National Forest, Idaho	Widespread. Some ponderosa pine saplings and poles were killed.
Western larch needlecast *Meria laricis* Vuill.	Western larch	Payette and Boise National Forests, Idaho	Scattered.

Pacific Southwest Region (R-5)

Forest Insect and Disease Management Staff
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and
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Honolulu, Hawaii

Conditions in Brief

The severe drought of 1975–77 was ended by heavy precipitation in the winter of 1977 and early spring of 1978. Nevertheless, trees continued to show the weakening effects of the drought.

Bark beetle activity shifted from the lower elevation pine type in central and northern California to the mixed conifer and fir types at the mid to upper elevations. Most trees infested were weakened as a result of moisture stress, adverse growing conditions, overstocking, mistletoe infection, root diseases, and/or man-caused disturbance. Future bark beetle activity will be influenced greatly by precipitation levels in the upcoming year. However, deficient precipitation will only tend to prolong the current high level of tree mortality.

There were continued damaging infestations of the lodgepole needle miner in Yosemite National Park and of the fruittree leafroller on oaks in the San Bernardino Mountains. Populations of the Douglas-fir tussock moth remained low.

Sugar pine saplings in the Sierra Nevada (Plumas National Forest), previously considered resistant to white pine blister rust, were infected in 1975 and 1976. From 15 to 75 percent of the trees were infected in some plantations.

Fomitopsis annosa, Verticicladiella wagenerii, and *Armillariella mellea* frequently were associated with bark beetle infestations. Dwarf mistletoes were found associated with large volume losses during the 1978 drought survey.

Fusarium oxysporum continued to be the major disease problem in forest nurseries.

Ozone injury symptoms were common on pines on the Sierra and Sequoia National Forests but ozone did not cause excessive injury.

In Hawaii, subnormal rainfall continued to foster disease and insect problems. The introduction of a chamaemyiid beetle predator of the Eurasian pine aphid appeared to be successful. The cause of Ohia decline remains unknown.

Status of Insects—California

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). Populations in Modoc County declined, while those in Calaveras and Tuolumne Counties increased slightly. A moderate increase occurred for the second consecutive year in El Dorado County where egg masses were found in some areas. The number of male moths caught in pheromone traps increased and some defoliation was visible.

Lodgepole needleminer, *Coleotechnites milleri* (Busck). High populations defoliated lodgepole pines on about 100,000 acres in the Merced and Tuolumne River drainages in Yosemite National Park. Extensive tree mortality occurred in Lyell Canyon and north of Tuolumne Meadows.

Western pine beetle, *Dendroctonus brevicomis* LeC. The western pine beetle continued to be a significant tree killer, alone and in combination with *Ips* spp., from the central Sierra Nevada south to the Tehachapi Mountains. Some of the new larger areas of concentrated tree killing were in French Creek, Butte County; Deer Creek, Tehama County; North Canyon Road and near the Auburn Dam Project, El Dorado County; Mi-Wuk Village, Tuolumne County; Yosemite Valley, Yosemite National Park, and Bass Lake, Madera County.

Pine engraver beetles, *Ips* spp. Tree killing by engraver beetles declined sharply in 1978. This dramatic decrease in tree mortality indicates that the forest is beginning to recover from effects of the recent drought.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. This beetle continued to kill many trees throughout northern California in both old- and young-growth sugar pine stands, but no concentrations of tree mortality were reported. Forest managers continued to express concern over the amount of mortality visible in apparently thrifty, vigorous young sugar pine stands. No reasons other than drought stress and high stocking levels were advanced to explain why these trees were being attacked by the beetle.

Jeffrey pine beetle, *Dendroctonus jeffreyi* Hopk. Although this beetle seldom was found on any of the drought survey plots, it was active throughout the range of its host. Attacks in eastside pine were frequently made in conjunction with the pine engraver, *Ips pini* (Say). The pine engraver seemed to be a more aggressive beetle than *D. jeffreyi*.

Fir engraver, *Scolytus ventralis* LeC. Fir engraver-caused true fir mortality rose sharply in Modoc and Siskiyou Counties and southward to Fresno County. Plumas, Sierra, Nevada, and Placer Counties were affected most severely. The fir engraver infested trees, both alone and in conjunction with *Melanophila* sp. and/or *Tetropium* sp. Overstocking, decadence, root disease, mistletoe infection, adverse site conditions, and drought seem to have triggered the upsurge in mortality observed this year.

Flatheaded and roundheaded borers, *Melanophila* spp. and *Tetropium* spp. The California flatheaded borer, *M. californica* Van Dyke, played a major role in killing ponderosa and sugar pines in northern California. The dead and dying pines were often infested only by flatheads, but it was not unusual to find flatheads together with various species of *Dendroctonus* and *Ips*. The roundheaded fir borer, *T. abietis* Fall, was found commonly in dead and dying true firs. In white fir, it was often mixed with the fir engraver, but in red fir it was generally by itself.

The flatheaded fir borer, *M. drum-*

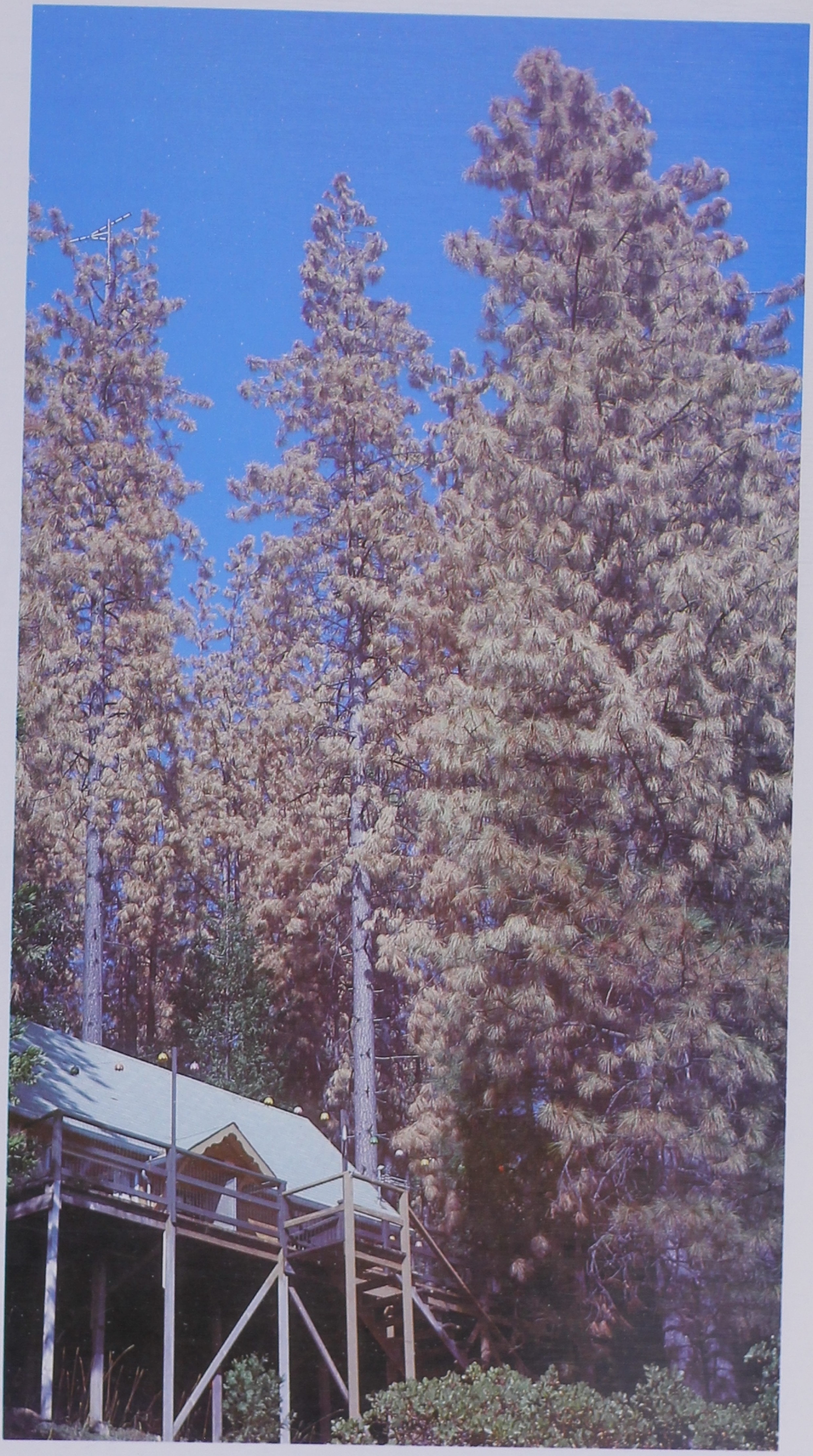
mondi Kby., was found occasionally in true fir, but was more common in Douglas-fir. This insect was associated with increased Douglas-fir mortality in northwestern California, where overmaturity, severe sites, and hardwood competition were other contributing factors.

Cone and seed insects. The fir coneworm, *Dioryctria abietivorella* (Grote), and the Douglas-fir cone midge, *Contarinia oregonensis* Foote, were the most severe and ubiquitous pests of Douglas-fir cones in the Placerville Nursery this year. These two insects were responsible for losses of 56 percent of the potential seed crop and 83 percent of the actual seed crop at the Badger Hill Breeding Arboretum.

Status of Insects — Hawaii

Eurasian pine aphid, *Pineus pini* Koch. This aphid continues to be the primary insect pest of pines on the islands of Maui and Molokai, and it has now been found on Kauai. The population of *Leucopis obscura* Haliday, a Chamaemyiid predator of the aphid, which was imported in 1976, has increase significantly.

Other Insects. The number of reports of the eucalyptus longhorn beetle, *Phoracantha semipunctata* Fab., on *Eucalyptus robusta* (Sm.) were more numerous than in 1977. Mortality of *Acacia koa* (Gray) seedlings occurred at the Maui Forestry Nursery when the auger beetle, *Sinoxylon conigerum* (Gerst.), invaded the nursery from an adjacent lot which was being cleared of shrubs. *Aleurodicus dispersus* Russell, a whitefly new to the State, was found on false kamani trees (*Terminalia catappa*) in Honolulu. The insect is suspected to be a vector of lethal yellowing of palms, a threat to the native palms of Hawaii's forests.



Ponderosa pine killed by the western pine beetle and pine engravers in an area of leisure home development.

F-701518

Other Insects (R-5)

Insect	Host	Location	Remarks
Silverspotted tiger moth *Halisidota argentata* Pack.	Sargent cypress Douglas-fir	Throughout California. Infestation in Mendicino County	Considerable mortality in localized area; not serious in other areas.
White fir sawfly *Neodiprion* nr. *abietis*	White fir	Modoc to Tuolumne Counties, Calif.	Common, but no serious infestations.
Budworms *Choristoneura* spp.	White fir	Siskiyou and Modoc Counties, Calif.	Low populations (possibly include *C. occidentalis*).
Tent caterpillar *Malacosoma* sp. (probably *californicum fragile*)	Bitterbrush	Inyo County, Calif.	Population collapsed on 38,000 acres defoliated between 1973 and 1977.
Jeffrey pine needleminer *Coleotechnites* sp. nr. *milleri*	Jeffrey pine	San Bernardino County, Calif.	Static infestation.
Red turpentine beetle *Dendroctonus valens* LeC.	Sugar pine Ponderosa pine	Throughout California	Aggressive on drought-stressed trees.
Pine needle weevil *Scythropus* sp.	Ponderosa pine Coulter pine Knobcone pine Monterey pine Jeffrey pine	Throughout California	Caused premature needle fall of older foliage.
Gall wasp *Cynips* sp.	Oak	Kern and Fresno Counties, Calif.	Common.
Pine needle scale *Chionaspis pinifoliae* (Fitch)	Lodgepole pine	Mono County, Calif.	On overmature hosts.
Coneworm *Dioryctria* sp.	Ponderosa pine Sugar pine Douglas-fir	Butte County, Calif.	Bud damage and damage to grafted seedlings.
Western pineshoot borer *Eucosma sonomana* Kft.	Ponderosa pine Jeffrey pine Lodgepole pine	Throughout northern California	Of increasing importance as reforestation accelerates.
Eucosma ponderosae Powell	Ponderosa pine Jeffrey pine	Throughout host range in California	Caused low seed losses.
Pine seedworms *Laspeyresia* spp.	Ponderosa pine Jeffrey pine	Throughout host range in California	Caused low to moderate seed losses.
Western conifer seedbug *Leptoglossus occidentalis* Heidemann	Ponderosa pine Jeffrey pine	Sierra Nevada in California	Widespread light damage.

Other Insects (R-5) *(Continued)*

Insect	Host	Location	Remarks
Sugar pine cone beetle *Conopthorus lambertianae* Hopk.	Sugar pine	Throughout host range in California	Locally severe.
Ponderosa pine cone beetle *Conopthorus ponderosae* Hopk.	Ponderosa pine	Throughout host range in California	Locally severe.
Argyresthia libocedrella Busck	Incense cedar	Shasta County and Cleveland National Forest, Calif.	Light populations on cones.
Asynapta keeni (Foote)	Ponderosa pine	El Dorado National Forest, Calif.	Locally abundant in cones.
Douglas-fir cone moth *Barbara colfaxiana* (Kft.)	Douglas-fir	El Dorado and Shasta Counties, Calif.	Minor damage to cones.
Fruittree leafroller *Archips argyrospilus* (Walk.)	Oak Fruit trees	Lake Gregory, Calif.	Heavy defoliation and increasing populations.
Gall mite *Eriophyes parapopuli* (K.)	Quaking aspen	Mono County	Galls not numerous enough to effect form of ticks.
Semanotus sp.	Incense cedar	Nevada County	Found 10–12 drought-stressed trees.
Pandora moth *Coloradia pandora* Blake	Jeffrey pine	Kern County	Multiple sightings of moths.
Boxelder bug *Leptocoris trivittatus* (Say)	Maple	Los Angeles County	On trees apparently damaged by air pollution.
Douglas-fir engraver *Scolytus unispinosus* LeC.	Douglas-fir	Humboldt, Eldorado, and Del Norte Counties	Primarily top-kill.
Acraspis sp.	Oak	Madera County	Tree vigor not affected.
Cicada	Douglas-fir	Plumas County	Localized on Douglas-fir saplings.
Sawfly *Neodiprion* sp.	Ponderosa pine, Douglas-fir	Siskiyou County	Defoliating small trees on localized area.
Shorthorn grasshoppers *Acrididae*	CP, MP, AP, PP	Los Angeles County	On newly planted seedlings at Castaia Lake and at Hog Burn.

Other Insects (R-5) *(Continued)*

Insect	Host	Location	Remarks
Douglas-fir twig weevil *Cylindrocopturus furnissi* Buch.	Douglas-fir	Trinity County	Mortality of approximately 1/3 of the reproduction in several cut blocks.
Gouty pitch midge *Cecidomyia piniinopis* O.S.	Ponderosa pine	Siskiyou County	Generally low populations throughout California.
Spider mites Tetranychidae	Ponderosa pine	Tree improvement Center, Chico, Calif.	1,000 newly grafted seedlings treated.

Status of Diseases — California

White pine blister rust, *Cronartium ribicola* J.C. Fisch. Blister rust infection of sugar pines was unusually heavy. The percentage of sugar pines infected in a plantation on the Plumas National Forest increased from a previous level of 15 percent to 75 percent. The rust increase in several other Sierra Nevada plantations that were examined was less dramatic, but cankers originating in 1975 and 1976 were abundant.

Annosus root rot, *Fomitopsis annosa* (Fr.) Karst. Annosus root rot continues to be a serious and frequent cause of mortality and failure in the pine and fir forests. It is especially damaging in recreation sites in southern California and in the eastside pine type.

Black-stain root disease, *Verticicladiella wagenerii* (Kend.). Continued damage to ponderosa pine on the Shasta-Trinity and Eldorado National Forests caused by a black-stain/bark beetle complex was evident in 1978.

Drought. Between June 1977 and June 1978, an estimated 5.8 million trees died that contained 5.5 billion board feet on 6,331,940 acres of commercial forest land in the 12 northern forests of California. The greatest volume loss (87 percent) occurred on better sites. Seventy-six percent of the volume loss was in the mixed conifer type and 74 percent was in ponderosa pine and white fir.

Insects and diseases appeared to play two main roles in contributing to 99 percent of this tree mortality. Endemic pests such as root diseases and mistletoes predisposed their hosts to earlier and more severe drought stress, while the more aggressive bark beetles and flatheaded borers killed the weakened, stressed trees.

Stem canker of red and white firs. A detection survey during 1978 was conducted to determine the prevalence and distribution of a bole canker in densely stocked young fir stands in the northern Sierras and Cascade Range. The canker was present in all stands examined in Shasta, Plumas, and Placer Counties, and was common in some of these stands. In El Dorado, Amador, Calaveras, and Tuolumne Counties, the canker was absent from some stands and, in the stands where it was present, it was less common than in the infected stands examined in the northern counties. University of California pathologists have isolated some fungi from the cankers. Pathogenicity tests are being conducted. Several insects also were associated with the cankers. A pitch moth, *Vespamima* sp., was frequently found boring in the cambial region at the edges of cankers; and a longhorned borer, *Strictoleptura canadensis*, was recovered from the dead wood behind a canker. Woodborers and decay contribute to the likelihood of stem breakage.

Status of Diseases — Hawaii

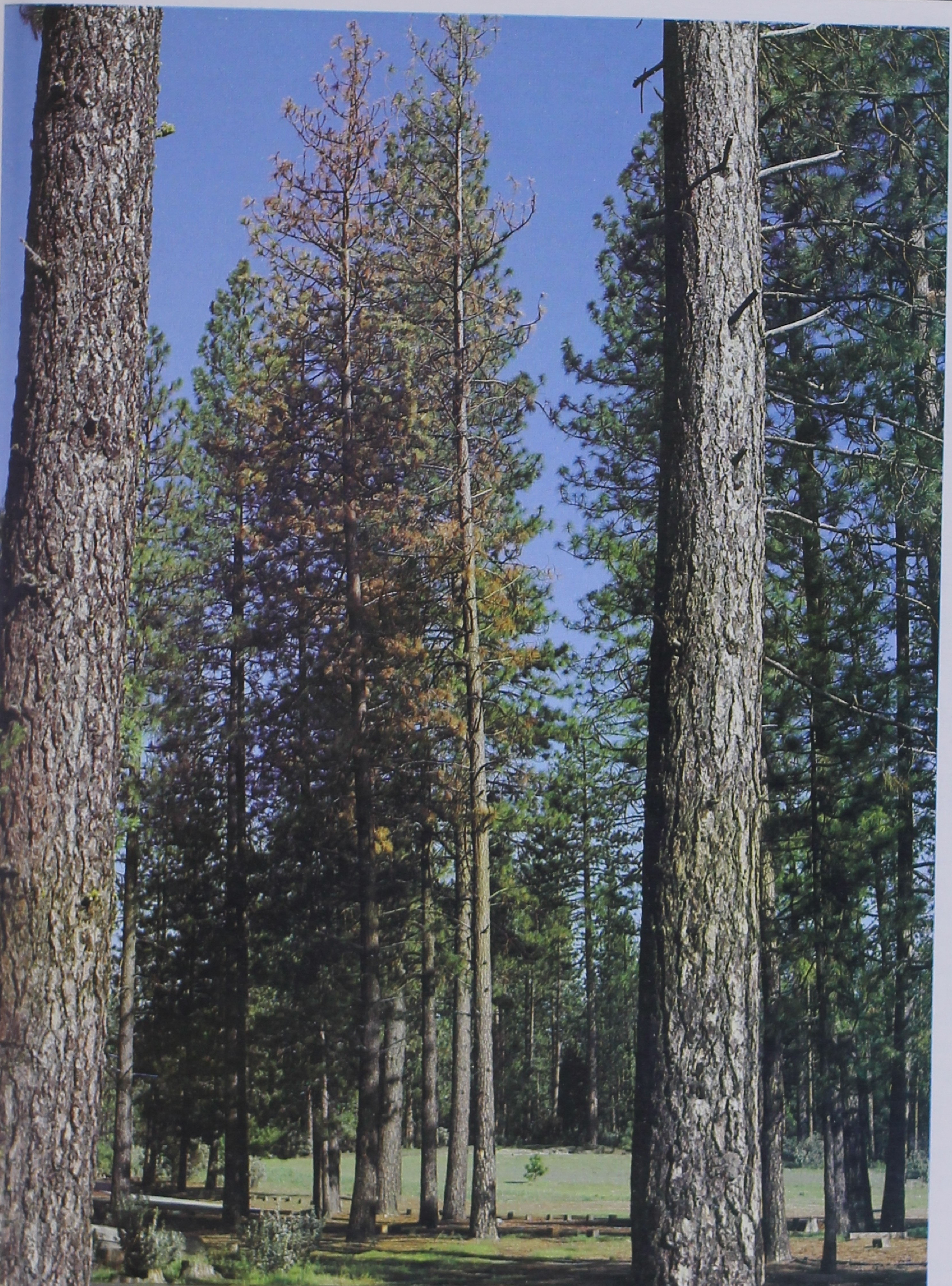
Ohia forest decline. The woodborer *Plagithmysus bilineatus* Sharp and the root rot fungus *Phytophthora cinnamomi* Rands are now considered secondary pests in the Ohia decline syndrome. Future studies will be focused on site factors.

Diplodia tip blight and lophodermium needle cast. The combination of *Diplodia pinea* (Desm.) Kickx. and *Lophoderium pinastri* (Schrad. ex Hook) Chev. is the primary disease problem in the Monterey and pinaster pine stands of the island of Molokai.

Eucalyptus canker, *Diaporthe cubensis* Bruner. This disease was first reported on Kauai in 1976 and new infested areas were found this year. Of the eucalyptus planted in Hawaii, *E. saligna* Sm. seems to be most frequently affected.

Slash pine root disease. A root rot disease on *Pinus elliottii* Engelm. was detected in the 1200 acre Kokee plantation on the island of Kauai. This disease may have caused diebacks reported since 1974 from this same area. The cause of this disease in unknown.

The total drought/pest-caused losses that have occurred over the past 3 years in California are now estimated at 12.3



An annosus root rot center in a recreation site.

F–701519

million trees and 8.6 billion board feet of timber.

Nursery diseases. *Fusarium oxysporum* (Schl.) em Snyd. & Hams. was the major disease problem in State and Federal forest nurseries in California. This fungus killed 44 percent of the 1-0 sugar pine and 46 percent of the red fir at Magalia Nursery. It also caused losses in Jeffrey and Scots pine, giant sequoia, and Russian olive. At Placerville Nursery, 7 percent of the 1-0 sugar pine were killed by *F. oxysporum*. Ben Lomond Nursery had scattered mortality in 1-0 Douglas-fir, Coulter pine, and Monterey pine beds.

Pythium sp. killed potted 2-0 sugar pine and rooted Douglas-fir at the Chico Tree Improvement Center and caused some mortality in 1-0 Jeffrey pine, ponderosa pine, and white fir at Magalia Nursery.

About 3 million 1-0 Jeffrey and ponderosa pine seedlings at the Placerville Nursery are too small for outplanting. This stunting is associated with the lack of mycorrhizae.

Table 4.—*Drought-related mortality on 6.3 million acres of commercial timberland on 12 National Forests in northern California, 1978*

Insect or Disease	Number trees killed	Volume killed
	Thousand	Million board feet
Dendroctonus brevicomis	1,701	1,402.6
Dendroctonus jeffreyi	75	5.8
Dendroctonus ponderosae	717	451.2
Ips spp.	325	133.3
Scolytus ventralis	1,188	114.1
Melanophila californica	107	51.0
Melanophila drummondi	330	410.3
Other insects	432	527.7
Total insects	4,245	3,096.0
Fomitopsis annosa	205	84.8
Armillariella mellea	55	22.6
Verticicladiella wagenerii	14	5.6
Arceuthobium campylopodum	620	972.2
Arceuthobium abietinum f. sp. *concoloris*	146	514.7
Arceuthobium abietinum f. sp. *magnificae*	55	133.4
Arceuthobium californicum	61	285.9
Other disease	93	9.1
Injury	276	400.3
Total diseases	1,527	2,428.6
Total All Causes	5,772	5,524.6

Other Diseases (R-5)

Disease	Host	Location	Remarks
Red Band *Dothistroma pini* (Hulb.)	Monterey pine	Humboldt County, Calif.	
Lophodermium pinastri (Schrad. ex Hook) Chev.	Monterey pine, sugar pine	Sonoma County, Calif.	
Atropellis Canker *Atropellis piniphila* (Weir.) Lohm and Cash	Lodgepole pine	El Dorado County, Calif.	Common.
Phomopsis Gall *Phomopsis* sp.	Live oak	San Bernadino County, Calif.	
Limb Rust *Cronartium coleosporioides* (Diet. & Holw.) Arth.	Jeffrey pine	San Bernadino County, Calif.	
Damping-off *Pythium* spp.	Sugar pine, Douglas-fir	Butte County, Calif.	
Damping-off *Rhizoctonia* spp.	Giant sequoia	Butte County, Calif.	

Pacific Northwest Region (R-6)[1]

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Conditions in Brief

Bark beetle activity increased in Washington but decreased in Oregon. The increase in Washington is attributed to the effects of the severe drought of 1976–77. The mountain pine beetle continued to kill lodgepole and ponderosa pine in eastern Oregon and Washington. The western pine beetle killed more than twice as many mature ponderosa pine in 1978 as it did in 1977 in central and southwestern Oregon. Losses caused by the Douglas-fir beetle declined in Oregon and Washington.

Western spruce budworm infestation decreased dramatically in Oregon and Washington. The area defoliated on the Warm Springs Indian Reservation was one-third the size of last year's infestation. In Washington, defoliation was visible on less than one-fifth of the area defoliated last year.

Root diseases most seriously affected forest productivity. Generally there is little change in root disease incidence from year to year. Armillaria root rot is widespread in the Region and caused significant mortality in localized areas. Several new black-stain root disease centers were detected in western Oregon and Washington in 1978. The Washington State Department of Natural Resources is moving cautiously into direct control of armillaria and laminated root rots. Annosus root and butt rot was found infecting and decaying up to 30 percent of the western hemlock stems in rotation age (50–80 year) stands. More infection was found in thinned than in unthinned stands.

Needle diseases were prevalent on western larch in northeast Washington. This was the result of a moist spring. Leaf curling and browning were common throughout the range of big leaf maple.

Charcoal root disease killed Douglas-fir seedlings in an Umpqua, Oreg., nursery. The disease may have been introduced on transplant seedlings. This appears to be the first time this potentially serious disease has been reported in Oregon.

Dutch elm disease has not been found in any Washington communities except Walla Walla. There have been no new reported findings in Oregon. No infested trees were detected in Portland in 1978.

Status of Insects

Western spruce budworm, *Choristoneura occidentalis* Free. The area defoliated by the western spruce budworm in Washington and Oregon decreased from 1.2 million acres in 1977 to 0.2 million acres in 1978. The amount of defoliation observed on the North Cascade National Park, Okanogan and Wenatchee National Forests, and adjacent State and private lands declined. There was visible defoliation on the Colville and Yakima Indian Reservations in Washington. The budworm infestation on the Warm Springs Indian Reservation in Oregon decreased in size and severity.

Egg mass surveys in the fall of 1978 indicated that populations of western spruce budworm declined in most areas except on the Warm Springs Indian Reservation in Oregon, and on a few areas on the Okanogan National Forest and adjacent State and private lands in Washington. The need for direct control in 1979 is under study.

Douglas-fir tussock moth, *Orgyia pseudotsugata* (McD.). Defoliation caused by this insect was detected on 18,078 acres in south-central Oregon this year. Pheromone traps were placed in the area in late summer but very few males were caught. A virus disease and parasites caused a collapse of this population.

Elsewhere, individual larvae were recovered from defoliator monitoring plots on the Deschutes, Winema, Ochoco, and Malheur National Forests in eastern Oregon, and on the Colville Indian Reservation in north-central Washington. Low populations were observed for the eighth consecutive year at Mare's Egg Spring on the northwest side of upper Klamath Lake, Winema National Forest, Oreg.

Larch casebearer, *Coleophora laricella* (Hbn.). The larch casebearer continued to defoliate western larch in eastern Washington and Oregon. No formal aerial survey was made to determine the extent or intensity of defoliation in 1978, but field observations indicated that defoliation was at about the same level reported in 1977.

Several introduced larch casebearer parasites were collected from release plots in Oregon and Washington in 1978. Two such parasites, *Agathis pumila* (Ratz.) and *Chrysocharis laricinellae* (Ratz.), are now established in northeastern Washington and northeastern Oregon. In 1978, Boise Cascade and Kinzua Corporations participated in the release of *C. laricinellae* in other areas in Oregon. Both parasites will continue to spread and increase within the next few years, and in so doing will aid in reducing casebearer populations.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. The mountain

Table 5.—*Area defoliated by western spruce budworm in 1977 and 1978*

State	Acres defoliated 1977	Acres defoliated 1978
Washington	1,175,820	192,970
Oregon	18,890	5,980
Total	1,194,710	198,950

There were no western spruce budworm supression projects in the Region in 1978.

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[1] Includes Forests in Oregon and Washington.

Based on cooperative surveys made by the Oregon State Department of Forestry, Washington Department of Natural Resources, and the Forest Service. Some information on shade and ornamental pests was provided by the Oregon State Department of Agriculture.

pine beetle continued to be the most destructive tree killer in the Pacific Northwest. Since 1967 this insect has killed about 1.3 billion board feet of pine on 1.7 million acres. Timber sales are being planned or are in progress in many infested areas to use the infested and dead trees, and there are plans to rehabilitate the site.

The largest outbreak is located on the Malheur, Umatilla, and Wallowa-Whitman National Forests and adjacent State and private lands in northeast Oregon. Mountain pine beetles in this area are attacking lodgepole pine, and old-growth and second-growth ponderosa pine. Losses in lodgepole pine stands in 1978 are estimated at 19 million board feet on about 1 million acres. The mountain pine beetle outbreak is still expanding into the remaining unmanaged stands of mature lodgepole pine. In the older outbreak areas, tree mortality is starting to decline because most suitable host trees have been killed. Losses in mature and immature ponderosa pine stands decreased within the outbreak area in 1978. Estimated losses of 141.8 million board feet occurred on 538,480 acres this year. The greatest losses were in unmanaged second-growth ponderosa pine stands northeast of Prairie City and between Baker and La Grande, Oreg. Mature ponderosa pines on exposed, dry sites were most susceptible to beetle attack.

Elsewhere in the Region, the mountain pine beetle killed many lodgepole pines on the Deschutes, Fremont, and Winema National Forests and adjacent State and private lands in Oregon, and on the Colville National Forest in Washington. In the ponderosa pine type, tree mortality occurred on the Deschutes, Mt. Hood, Ochoco, and Winema National Forests and on the Warm Springs Indian Reservation in Oregon. In Washington the Okanogan, Wenatchee, and Colville National Forests, Colville Indian Reservation, and State and private lands north of Spokane sustained the greatest damage. Mountain pine beetle outbreaks in western white pine stands increased in Washington but decreased in Oregon in 1978. In Oregon, tree mortality was on the Mt. Hood, Umpqua, Deschutes, Wallowa-Whitman, and Willamette National Forests. In Washington, tree killing occurred on the Wenatchee, Colville, Okanogan, and Olympic National Forests, Olympic National Park, and Yakima Indian Reservation.

Scattered sugar pines were killed on the Willamette, Rogue River, Umpqua, and Winema National Forests and surrounding lands in Oregon. Some whitebark pines in Washington were killed by the beetle.

Western pine beetle, *Dendroctonus brevicomis* LeC. Western pine beetle outbreaks in mature ponderosa pine were extensive throughout eastern Washington and even more intense in Oregon in 1978. In total, 19.5 million board feet of ponderosa pine were killed on 242,930 acres in the Region. In Oregon, most of the losses occurred on the Deschutes, Fremont, Winema, Ochoco, and Malheur National Forests, Warm Springs Indian Reservation, and adjacent State and private lands. In Washington, losses were greatest on the Wenatchee National Forest and the Colville Indian Reservation. Timber sales and sanitation-salvage sales are in progress or being planned for most outbreak centers.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Tree killing by the Douglas-fir beetle declined in Oregon and Washington. The insect killed about 10.8 million board feet on 46,450 acres in the Region. Most of the losses, 7.7 million board feet, occurred on the Umatilla and Wallowa-Whitman National Forests, and adjacent State and private lands in eastern Oregon and Washington. Most of the losses occurred in areas that had been defoliated heavily by Douglas-fir tussock moth between 1972 and 1974. Elsewhere, scattered tree mortality was observed on the Rogue River, Siuslaw, Mt. Hood, Siskiyou, Umpqua, and Willamette National Forests in western Oregon. In Washington, losses were reported on the Gifford Pinchot and Olympic National Forests and the Olympic and North Cascades National Parks. Where feasible, timber and salvage sales are in progress or are being planned.

Pine engraver beetles, *Ips* spp. The 1976–77 drought is believed to have weakened many pines, making them attractive to attack by the pine engraver. Tree mortality caused by these beetles increased in 1978. Damage was observed on 345,000 acres in Oregon and Washington. The heaviest damage was reported on the Deschutes, Fremont, Wallowa-Whitman, Mt. Hood, and Umatilla National Forests and Warm Springs Indian Reservation in Oregon and on the Okanogan and Wenatchee National Forests and Yakima Indian Reservation in Washington.

Fir engraver, *Scolytus ventralis* LeC. Tree killing by this beetle increased in Oregon and Washington. Losses in true fir stands are estimated at 2.8 million board feet on 41,405 acres. Most damage occurred in unmanaged stands on the Fremont, Winema, Malheur, Wallowa-Whitman, and Umatilla National Forests in Oregon and on the Wenatchee and Colville National Forests in Washington.

Spruce beetle, *Dendroctonus rufipennis* (Kby.). Spruce beetle infestations increased from 2,240 acres in 1977 to 6,710 acres in 1978. All of the losses, an estimated 2.75 million board feet, occurred in Washington on the Okanogan and Wenatchee National Forests.

Western oak looper, *Lambdina fiscellaria somniaria* (Hulst). During the summer of 1978, the Pacific Northwest Forest and Range Experiment Station conducted a field test on 20 acres with two formulations of Thuricide® against this insect. Since the oak looper is a subspecies of the hemlock looper, it is anticipated that the treatment will be equally effective against the hemlock looper.

Tent caterpillar, *Malacosoma* sp. Populations of this insect were observed defoliating alders and willows in Oregon along the Columbia River from Portland, north to St. Helens. In southwest Washington, defoliation of alder and other broadleaf trees was reported.

Fall webworm, *Hyphantria cunea* (Drury). Fall webworm populations were heavy in ornamental shade trees in Marion County, Oreg.

Gypsy Moth, *Lymantria dispar* (L.). A number of male gypsy moths were trapped near Seattle in 1978. In a subsequent egg mass survey conducted this fall by the Animal and Plant Health Inspection Service and the Washington State Department of Agriculture, 33 egg masses were found. Of the 33, 29 were destroyed and 4 were caged to determine egg hatch for timing of the eradication project planned in the spring of 1979.

Black pineleaf scale, *Aspidiotus californica* Coleman. The area of pine forests damaged by this insect decreased from 10,970 in 1977 to 9,330 acres in 1978. Infested areas were detected along the west edge of upper Klamath Lake in south-central Oregon.

Balsam woolly aphid, *Adelges piceae* (Ratz.). Damage caused by this insect was observed on 5,930 acres of true fir stands in western Washington. A new infestation center was detected on State and private lands in the Blue Mountains near the headwaters of the Walla Walla River in Oregon. Heavy populations were observed on subalpine fir and it is believed that the insect became established in recent years. This center is about 15 miles southwest of the area where the balsam woolly aphid was originally discovered in the Blue Mountains in 1974.

Table 6.—*Bark Beetle Infestations in Oregon and Washington (R-6), 1978*[1]

	Infestations			
State, Insect, Host(s)	Number	Acres	Number of trees	Infested volume (MBF)
Oregon				
Douglas-fir beetle (east-side Douglas-fir)	428	22,130	8,766	4,806.84
Douglas-fir beetle (west-side Douglas-fir)	138	7,680	1,064	1,711.60
Fir engraver	342	28,355	5,257	1,710.79
Flatheaded wood borer	231	13,360	2,322	139.32
Mountain pine beetle (Ponderosa pine)	1,403	576,700	728,209	143,306.17
Mountain pine beetle (Sugar pine)	34	2,500	230	227.10
Mountain pine beetle (Western white pine)	66	4,620	1,038	491.48
Mountain pine beetle (Lodgepole pine)	1,914	1,199,180	1,872,772	130,312.97
Western pine beetle	1,264	227,710	21,078	16,498.99
Totals	5,820	2,082,235	2,640,736	299,205.26
Washington				
Douglas-fir beetle (east-side Douglas-fir)	253	15,760	7,713	4,223.40
Douglas-fir beetle (west-side Douglas-fir)	11	880	70	62.65
Douglas-fir engraver	12	80	10	0.60
Engelmann spruce beetle	16	6,710	11,025	2,756.25
Fir engraver	216	13,050	3,878	1,065.40
Mountain pine beetle (Ponderosa pine)	577	52,860	22,394	1,359.38
Mountain pine beetle (Western white pine)	464	59,730	32,219	15,692.83
Mountain pine beetle (Lodgepole pine)	65	13,460	17,804	1,246.28
Mountain pine beetle (Whitebark pine)	4	1,190	1,160	81.20
Western pine beetle	242	15,220	2,062	1,045.19
Totals	1,850	178,940	98,335	27,533.18
Regional totals	7,670	2,261,175	2,739,071	326,738.44

[1] Excluding pine engraver.

Other Insects (R-6)

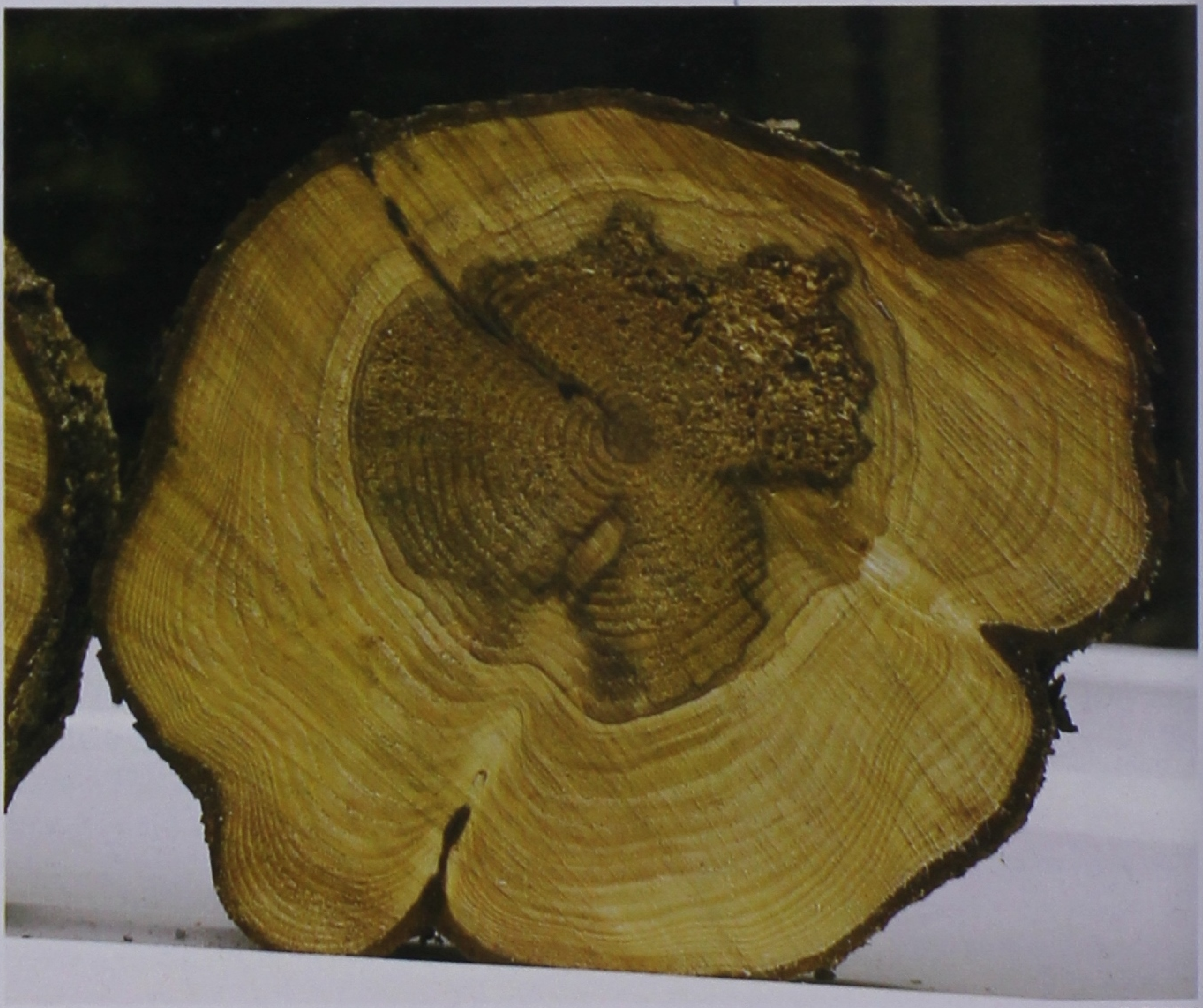
Insect	Host	Location	Remarks
Modoc budworm, *Choristoneura viridis* Free.	White fir	Fremont National Forest, Oreg.	Population collapsed in 1978.
Sawfly, *Neodiprion nanulus contortae* Ross	Lodgepole pine	Deschutes, Umpqua, and Winema National Forests, Oreg.	Light defoliation on about 3,000 acres.
Larch budmoth, *Zeiraphera improbana* (Walk.)	Western larch	Wenatchee National Forest, Wash.	Light defoliation on 10,950 acres, moderate on 2,670 acres.
Douglas-fir engraver, *Scolytus unispinosus* LeC.	Douglas-fir	Gifford Pinchot National Forest, Wash.	Reported killing trees on 80 acres.
Flatheaded borers, *Melanophila* spp.	Douglas-fir Ponderosa pine	Southwest Oregon	Killing drought-stressed trees on 1,360 acres.
Spruce aphid, *Neomyzaphis abietina* (Walk.)	Sitka spruce	Oregon Coast	Population collapsed.
Western oak looper, *Lambdina fiscellaria somniaria* (Hulst)	Oak	Washington, Yamhill, and Polk Counties, Oreg.	Moderate defoliation but populations are collapsing.

Status of Diseases

Laminated root rot, caused by *Phellinus weirii* (Murr.) Gilb., is one of the most damaging root diseases in the Northwest. Regionwide, about 5 percent of the Douglas-fir type is infected by this fungus. On one 600-acre stand on the Siuslaw National Forest, 18 percent of the area is out of commercial production because of laminated root rot.

Armillaria root rot, caused by *Armillariella mellea* (Vahl. ex Fr.) Karst., continued to damage both westside plantations and eastside mature stands in 1978. Several large disease centers caused by *A. mellea* were found on the Deschutes and Rogue River National Forests.

The Washington State Department of



Decay in western hemlock caused by Fomitopsis annosa.

F–701520

Other Disease (R-6)

Disease	Host	Location	Remarks
Needle Diseases *Lophodermella concolor* (Dearn.) Dark.	Lodgepole pine	Eastern Oregon and Washington	Incidence less than 1976, 1977.
Lophodermella morbida Staley & Bynum	Ponderosa pine	Southeast Oregon	Severe on trees planted off-site, scattered.
Hypodermella laricis Tub.	Western larch	Northeast Washington	Scattered.
Meria laricis Vuill.	Western larch	Northeast Washington	Scattered.
Lophodermium pinastri (Schrad. ex Hook) Chev.	Scots pine	Puget Sound,	Christmas trees severely infected
Rhabdocline pseudotsugae Syd.	Douglas-fir	Oregon and Washington	On trees planted off-site.

Natural Resources is moving cautiously into direct control of Armillaria root rot on State lands. A detailed management guide has been prepared for WDNR foresters.

Annosus root and butt rot, caused by *Fomitopsis annosa* (Fr.) Karst., infected and caused decaying in 30 percent of the western hemlock stems in rotation age (50–80 year) stands. More decay was found in thinned stands than in unthinned stands. Butt rot rather than tree mortality was the principal type of damage. A University of Washington survey found that an average of 38 percent of the trees in 21 unthinned western hemlock stands contained *F. annosa*. All stands were infected.

Black-stain root disease, caused by *Verticicladiella wagenerii* Kend., has been found in new areas in both Oregon and Washington in 1978.

A large infection center, covering 2 to 3 acres, was found near Forks, Wash.

Dwarf mistletoe. Control was recommended on 20 of 292 western hemlock plantations on Bureau of Land Management lands in Oregon. Only 20 plantations were classified as requiring treatment of residual trees and/or natural regeneration to reduce damage.

Twenty-two percent of all white fir trees sampled on the Fremont National Forest were infected by *Echinodontium tinctorium* (E. & E.) E. & E., the Indian paint fungus. Some trees had active decay but many contained dormant infections in sound wood.

Drought damage reappeared in hardwoods even though normal precipitation returned in 1978. Drought damage should subside if normal precipitation continues in subsequent years.

The most visible forest disease of 1978 was the curling and browning of big leaf maple foliage over the entire range of the tree. Causes of the overall tree browning, foliage discoloration, and premature leaf drop were the drought of 1977, heavy seed crops, and widespread infection by an anthracnose fungus, *Gloeosporium apocryptum* E. & E.

Several existing campgrounds and perspective campgrounds were examined for hazardous trees in 1978. Through training of campground personnel in recognition and proper treatment of hazardous trees, the number of accidents resulting from tree failures should decrease.

F-701521

Survey of infection and decay caused by the Indian paint fungus.

Walla Walla is still the only confirmed location of Dutch elm disease in Washington. There have been no new reports in the city of Portland where one diseased tree was found and removed in 1977. Portland has begun a Dutch elm disease control program.

Southern Region (R-8)[1]

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Forest Insect and Disease Management
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Conditions in Brief

Forest trees in the South are subject to attack by about 30 species of insects that may cause significant damage. Of these, the southern pine beetle, the fall cankerworm, and seed orchard insects deserve special attention. Southern pine beetle activity was greatest in Georgia and Mississippi. There was little or no activity in other States. Beetle populations will probably be low enough in 1979 for control by State agencies. Fall cankerworm defoliated 109,750 acres in 1978. Infestations adversely affected the esthetic quality of recreation areas, including parts of the Appalachian Trail, thereby creating increased public awareness of the pest. Coneworms caused increasing problems in southern seed orchards in 1978, but damage caused by conebeetles and coneborers diminished.

Annosus root rot, once viewed as an overwhelming threat, is still a major disease of pines, but is responding to control measures. Fusiform rust on pines, which damages more than 97 million cubic feet of growing stock annually, now occurs in at least 10 States. Recently developed control methods may help to reduce the impact of this disease. Pitch canker has declined in severity in recent years. Although fewer stands of pines were subjected to heavy losses from pitch canker in 1978 than previously, the disease seems to be gradually increasing in western Florida.

Other significant insects and diseases and mycorrhizae are discussed in the status reports. One major group of fungi, mycorrhizae, is discussed in a section separate from forest diseases because these fungi are beneficial organisms and could play an important part in establishing new forests in the future.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. Southern pine beetle outbreaks decreased dramatically in most areas during 1978. In Texas, Arkansas, and Louisiana there were 90 percent fewer spot infestations than the previous year. Beetle populations were at endemic levels in Oklahoma, Alabama, Virginia, Kentucky, North Carolina, South Carolina, Tennessee, and Florida. In Mississippi, activity decreased from past years but remained at moderate levels with large infestations, averaging 57 trees per spot in the east, central, and northeastern portions of the State. The only State with an apparent upswing in beetle activity was Georgia, where about 100 new spot infestations of 10 to 200 trees were found on the Oconee National Forest. In 1979, southern pine beetle populations should be low enough for control action by State and Federal agencies.

Fall cankerworm, *Alsophila pometaria* (Harr.). The area infested by the fall cankerworm continued to increase in 1978, especially in Georgia, North Carolina, and Tennessee. New areas of defoliation were found on the Cherokee National Forest in Tennessee and Cumberland Gap National Historic Park in Kentucky.

In Georgia, the infestation continued to move southwestward, covering an additional 8,000 acres in 1978. North Carolina showed increases in acreage defoliated, but at the same time showed signs of declining infestations, especially in the older infested areas. The infestation on the Coweeta Hydrologic

Table 7.—*Trend of fall cankerworm infestations in the South 1970 to 1978*

State	Acres defoliated			
	1970	1974	1976	1978
North Carolina	800	4,000	20,000	45,500
Kentucky	0	0	0	250
Georgia	0	0	24,000	60,000
Tennessee	0	0	0	4,000
TOTAL	800	4,000	44,000	109,750

F-701522

Adult southern pine beetle in its gallery.

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[1] Includes forests in Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

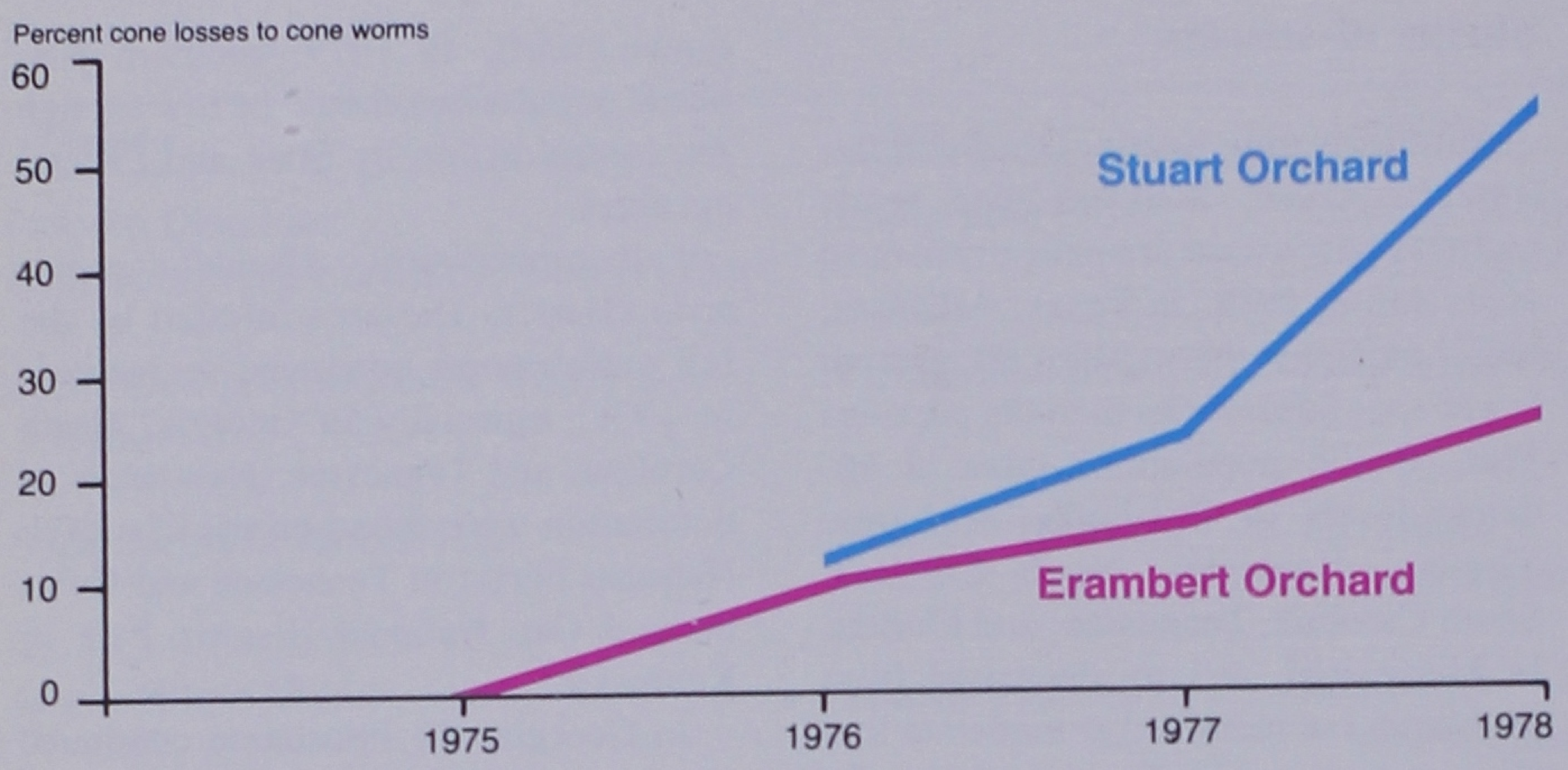


Figure 20—*Cone losses due to coneworms on untreated mature loblolly pines at the Stuart Orchard, La., and Erambert Orchard, Miss., 1975–78.*

Laboratory, where the current outbreak was first detected in 1968, has collapsed. Egg parasitism by a wasp, *Telenomus alsophilae* Vier., was probably responsible.

Seed Orchard Insects

There has been a general increase in cone damage by coneworms, *Dioryctria* spp., throughout the South. During 1978, one industrial seed orchard documented a 64 percent cone loss on unprotected trees. In addition, coneworms destroyed 34 percent of the cone crop on trees protected with carbofuran (10 percent granular), a systemic insecticide. Total losses in this orchard exceeded $750,000. Data from two seed orchards, the Stuart in Louisiana and the Erambert in Mississippi, showed similar increases in cone losses.

White pine cone beetle, *Conopthorus coniperda* (Schw.), and coneborer, *Eucosma tocullionan* Hein., together caused a 34 percent loss in cones on untreated white pine trees at the Beech Creek Seed Orchard, Murphy, N. C., in 1978. Losses on carbofuran-treated trees were 7 percent. Cone losses from these two pests on southern orchards were generally lower than in past years.

Populations of seedbugs, *Leptoglossus corculus* (Say) and *Tetyra bipunctata* (H.-S.), fluctuate from season to season and area to area. No information on the general trend is available on seedbugs. However, year in and year out, these insects cause considerable losses. Evidence of the loss that can occur from seedbug feeding was the 3 percent on a treated area on shortleaf pines at the Ouachita Orchard in Arkansas during 1977. Empty pine seed averaged 61.2 percent on untreated checks compared with 38.8 percent on trees treated with azihphos methyl or carbofuran on Federal seed orchards in 1977.

F–701523

Coneworms destroy much of the cone crop on unprotected trees in southern seed orchards.

Other Insects (R-8)

Insect	Host	Location	Remarks
Arkansas sawfly, *Neodiprion taedae linearis* Ross	Loblolly and shortleaf pine	13 western counties in Kentucky.	Light pine defoliation (10 to 20 percent) in western Kentucky.
	Loblolly and shortleaf pine	Alamance, Caswell, Guilford, Person, and Rockingham Counties, N.C.	Moderate to light defoliation.
Bagworm, *Thyridopteryx ephemeraeformis* (Haw.)	Aborviate, eastern redcedar, and white pine	Buncombe County, N.C.	Heavy defoliation and some mortality, especially in white pine plantations.
Eastern tent caterpillar, *Malacosoma americanum* (Fab.)	Black cherry	Florida, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, and Virginia.	Heavy defoliation in the mountains.
Elm leaf beetle, *Pyrrhalta luteola* (Mueller)	Elm	Kentucky, North Carolina, Tennessee, and Texas.	Defoliation increased to near outbreak proportions.
Forest tent caterpillar, *Malacosoma disstria* Hbn.	Tupelo gum, black gum, sweet gum, and various species of oak	Baldwin, Clarke, Mobile, and Washington Counties, Ala.; Ascension, Assumption, Iberville, Lafourche, Livingston, St. James, St. John the Baptist, St. Mary, Tangipahoa, and Terrebonne Parishes, La.; Gates County, N.C.	This insect defoliated over 50,000 acres in Alabama, 700,000 acres in Louisiana, and about 300 acres in Dismal Swamp Wildlife Refuge, N.C.
Gypsy moth, *Lymantria dispar* (L.)	Oak	Blount, Sevier, and Wilson Counties, Tenn.; Avery County, N.C.; Accomac, Clark, Fairfax, Loudon, and Prince William Counties, Va.	162 male moths trapped in 133 traps in Loudon County, Va.

Other Insects (R-8) *(Continued)*

Insect	Host	Location	Remarks
Hackberry butterfly, *Asterocampa celtis* (Bdv. and LeC.)	Hackberry and sugarberry	Desha County, Ark.; Bolivar, Claiborne, Coahoma, Issaquena, Warren, and Washington Counties, Miss.	Light defoliation in most areas, heavy in a few.
Introduced pine sawfly, *Diprion similis* Hartig.	White pine	Avery County, N.C.	Heavy defoliation.
Locust leaf-miner, *Odontota (Xenochalepus) dorsalis* (Thunb.)	Black locust	Kentucky, North Carolina, Tennessee, and Virginia.	Severe defoliation.
Oak sawfly, *Caliroa* spp.	Red oak	Kentucky, North Carolina, Tennessee, and Virginia.	Population declined drastically.
Orangestriped oak worm, *Anisota senatoria* (J. E. Smith.)	Cherrybark oak seedlings	Tennessee.	Defoliated 3 acres of cherrybark seedlings in Tennessee.
Poplar tent maker, *Ichthyura inclusa* Hbn.	Poplar and willow	Desha County, Ark.; Bolivar, Coahoma, Issaquena, and Washington Counties, Miss.	Defoliated an estimated 16,500 acres.
Shortleaf pine looper, *Anacamptodes vellivolata* (Hulst)	Shortleaf and loblolly pine	Anderson, Cherokee, Houston, Nacogdoches and Polk Counties, Tex.	This insect caused light defoliation on about 25,000 to 50,000 acres, with 1,500 to 2,000 acres heavily defoliated.
Variable oak leaf caterpillar, *Heterocampa manteo* (Dbldy.)	Oak	Grant Parish, La.; Calhoun, Grenada, and Lee Counties, Miss.; Halifax and Northampton Counties, N.C.	Moderate to heavy defoliation in some areas.
Virginia pine sawfly, *Neodiprion pratti pratti* (Dyar)	Virginia, pitch, jack, shortleaf, loblolly, and red pines	56 counties in southeastern Kentucky.	Light to moderate defoliation.

Other Insects (R-8) *(Continued)*

Insect	Host	Location	Remarks
Walkingstick, *Diapheromera femorata* (Say)	Black oaks and wild cherry preferred, but feed on many other hardwoods	Garland, Montgomery, Perry, Polk, Scott, and Yell Counties, Ark.; and Le Flore County, Okla.; Greene, Madison, Page, and Warren Counties, Va.	Defoliated 14,478 acres
Black turpentine beetle, *Dendroctonus terebrans* (Oliv.)	Pines	Grant Parish, La.; Wilkinson and Amite Counties, Miss.; counties throughout east Tex.; Dodge, Telfair, Treutlen, and Wheeler Counties, Ga.	A minor problem in longleaf stands. Most damaging when weather is dry.
Ips beetle, *Ips* spp.	Pine	Grant Parish, La.; Scott and Smith Counties, Miss.; McCurtain, Okla.; and counties throughout east Tex.; Florida; Edgefield, Greenwood, and McCormick Counties, S.C.; Dodge, Telfair, Treutlen, and Wheeler Counties, Ga.; and North Carolina.	Moderate timber losses with many scattered single, and small multiple tree spots.
Nantucket pine tip moth, *Rhyacionia frustrana* (Comst.)	Loblolly pine	Beckley, Decatur, and Montgomery Counties, Ga.	Severe damage with 5 to 10 percent mortality in plantations on about 250 acres each county and in the Meeman-Shelly State Park seed orchard

Other Insects (R-8) *(Continued)*

Insect	Host	Location	Remarks
Banded hickory borer, *Knulliana cincta* (Drury); Red oak borers, *Enaphalodes rufulus* (Hald.), *Romaleum rufulum*; Sugar maple borer, *Glycobius speciosus* (Say); Two lined chestnut borer, *Agrilus bilineatus* (Web.); White oak borer, *Goes tigrinus* (Deg.)	Northern red oak, scarlet oak, southern red oak, black oak, red maples, hickory	Kentucky	In Kentucky, wood borers of oak, maple, and hickory damaged 14,316,725 cubic feet of timber.
Columbian timber beetle, *Corthylus columbianus* (Hopk.)	Yellow poplar, hard pines	Kentucky	14,918,326 cubic feet of damage.
Pales weevil, *Hylobius pales* (Herbst.)	Southern pine seedlings	Georgia	4 percent of seedlings are still being lost to this insect in spite of insecticide treatment.
Balsam woolly aphid, *Adelges piceae* (Ratz.)	Fraser fir	North Carolina and Tennessee	Spreading into remaining and natural stands and adjacent Christmas tree plantations, despite control efforts.

Status of Diseases

Annosus root rot. Fifteen to twenty years ago, annosus root rot, caused by the fungus *Fomitopsis annosa* (Fr.) Karst., was viewed as an overwhelming threat to southern pine management. However, losses have not reached the expected level in the South. There are two reasons for this. First, high hazard sites are being treated with borax. Second, the number of thinnings is being reduced and thinnings are being done in the summer south of latitude 34 degrees N.

The small number of high hazard sites in Virginia and a reduction in thinnings has kept losses to a minimum in that State. However, in South Carolina and Georgia, losses in localized areas have been high. A 2-year drought and first thinnings with no protective stump treatments have contributed to the high incidence of annosus root rot in these areas. On the Oconee National Forest, a 22-year-old loblolly pine plantation was thinned about 5 years ago and no stump treatment was applied. The stand now has significant infection with numerous fruiting bodies found on stumps and trees.

Fusiform Rust, caused by *Cronartium fusiforme* Hedgc. & Hunt ex Cumm, has increased in intensity, distribution, and impact throughout the Southeast since 1900. This increase has closely coincided with the increase in plantation mangement.

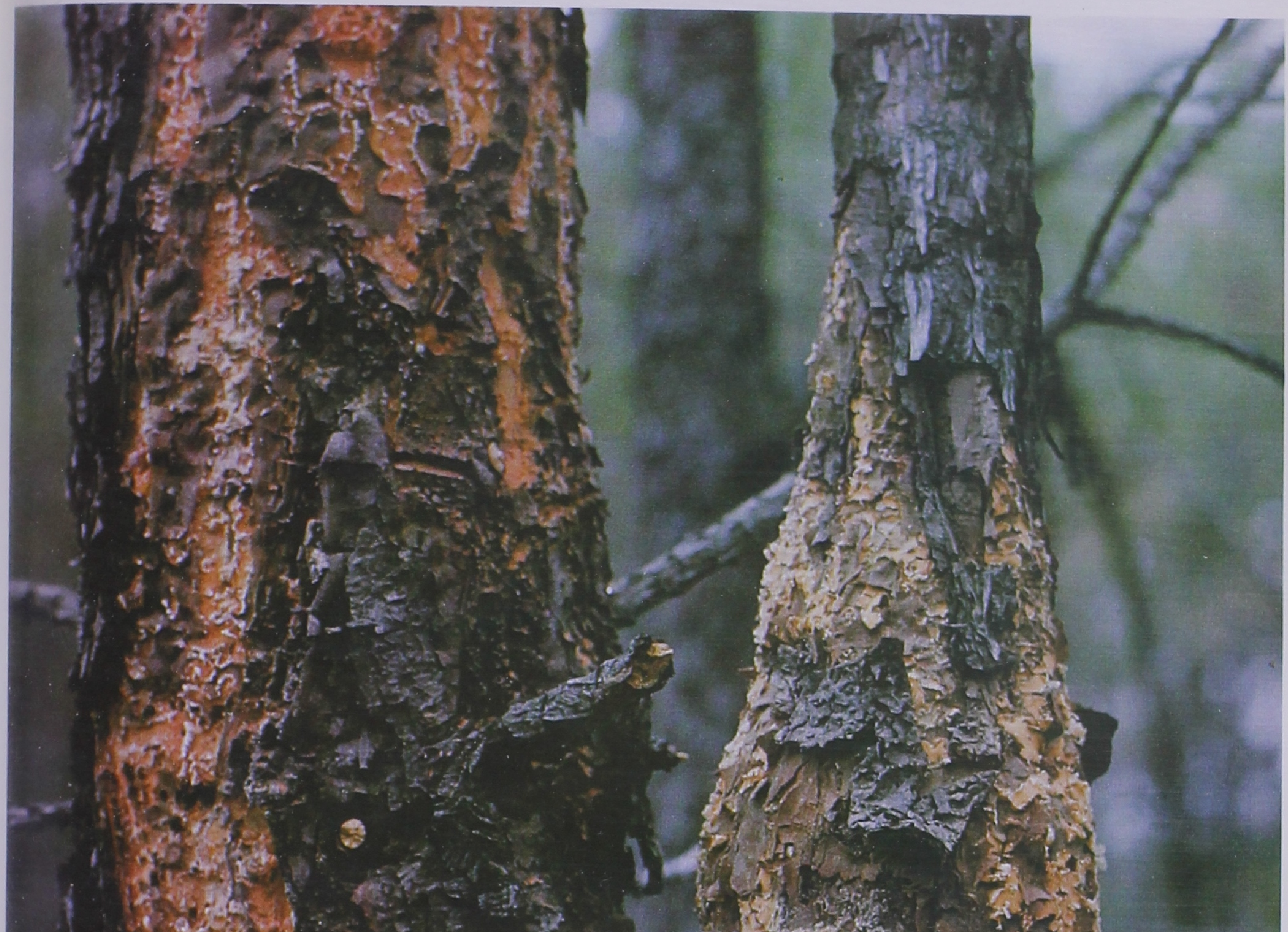
This disease is most severe in a wide land corridor from central Louisiana through Florida, and in parts of Texas, Arkansas, and Virginia. It limits the establishment and management of loblolly and slash pine throughout most of this highly vulnerable area. Fusiform rust incidence varies, but can increase 2 to 3 percent per year. Annual loss to fusiform rust is estimated to be about 100 million cubic feet of growing stock.

This disease is most damaging where susceptible pines are planted offsite. One example is the planting of slash pine on longleaf pine sites in central Louisiana.

Bcause approximately 1 million acres of susceptible pine are being planted each year, we would expect the damage to increase. However, losses may be reduced through integrated pest management strategies outlined in the *Management of Fusiform Rust in Southern Pines Symposium Proceedings, 1977*. These strategies combine rust resistance and silvicultural practices to reduce losses from fusiform rust.

Pitch canker, caused by *Fusarium moniliforme* var. *subglutinians* Wr. & Reink., is a cyclic disease that has caused substantial deformity, growth loss and mortality in slash and Virginia pine stands. Shortleaf, Scots, table mountain, pitch, loblolly, and sand pines are also susceptible. Most of the severely affected stands are in Florida and southern Georgia, but the disease occurs over a wide range in the South.

Recently, pitch canker has caused substantial damage in some seed or-



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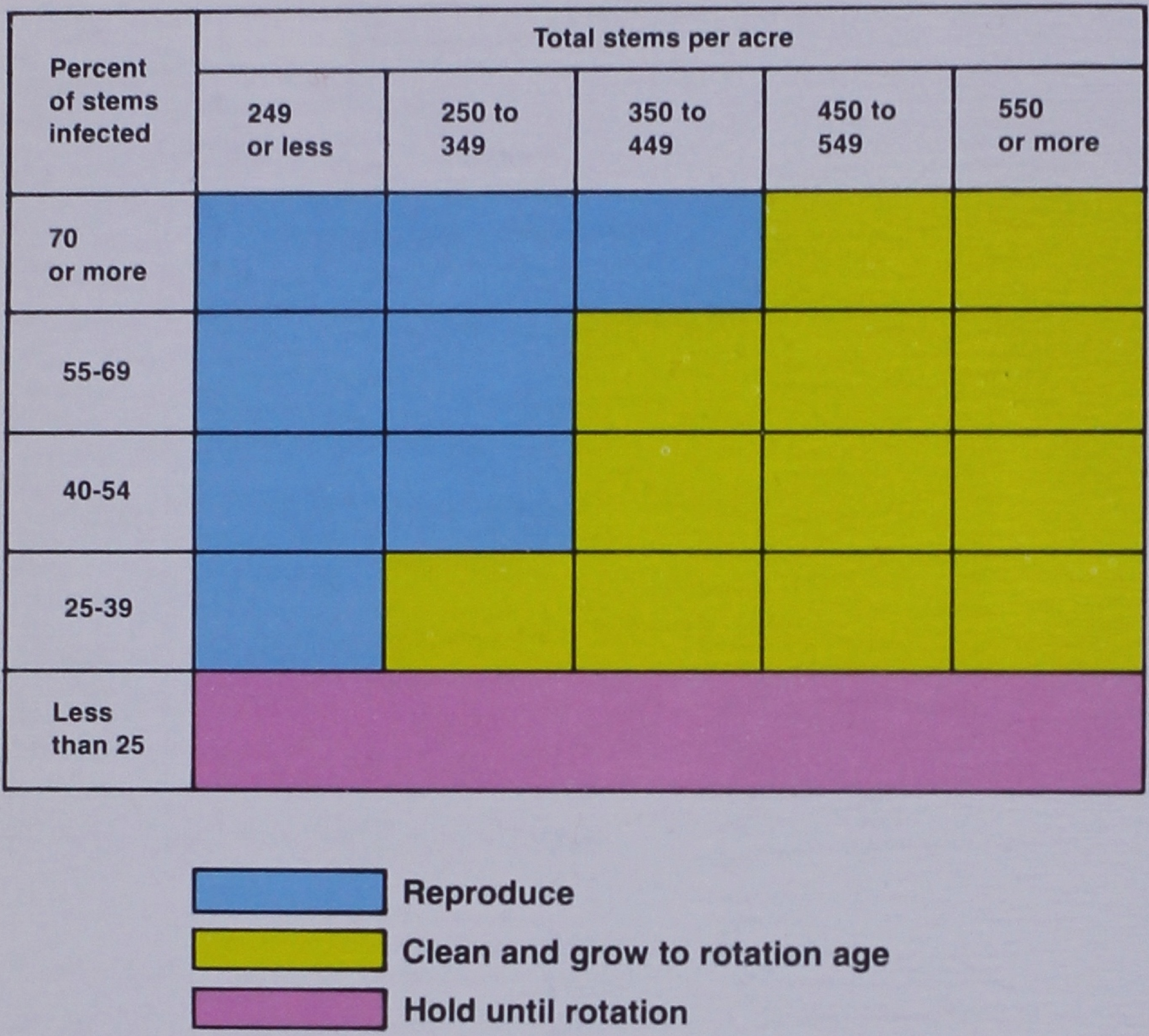
Fusiform rust limits the establishment and management of loblolly and slash pine in many areas.

chards. The affected trees were from pitch canker susceptible families.



Percent of stems infected	Total stems per acre				
	249 or less	250 to 349	350 to 449	450 to 549	550 or more
70 or more	🟦	🟦	🟦	🟨	🟨
55-69	🟦	🟦	🟨	🟨	🟨
40-54	🟦	🟦	🟨	🟨	🟨
25-39	🟦	🟨	🟨	🟨	🟨
Less than 25	🟪				

🟦 Reproduce

🟨 Clean and grow to rotation age

🟪 Hold until rotation

Figure 22—*A chart to help land managers make decisions on removing and thinning infected stands. (From* Management of Fusiform Rust in Southern Pines Symposium Proceedings, *1977)*

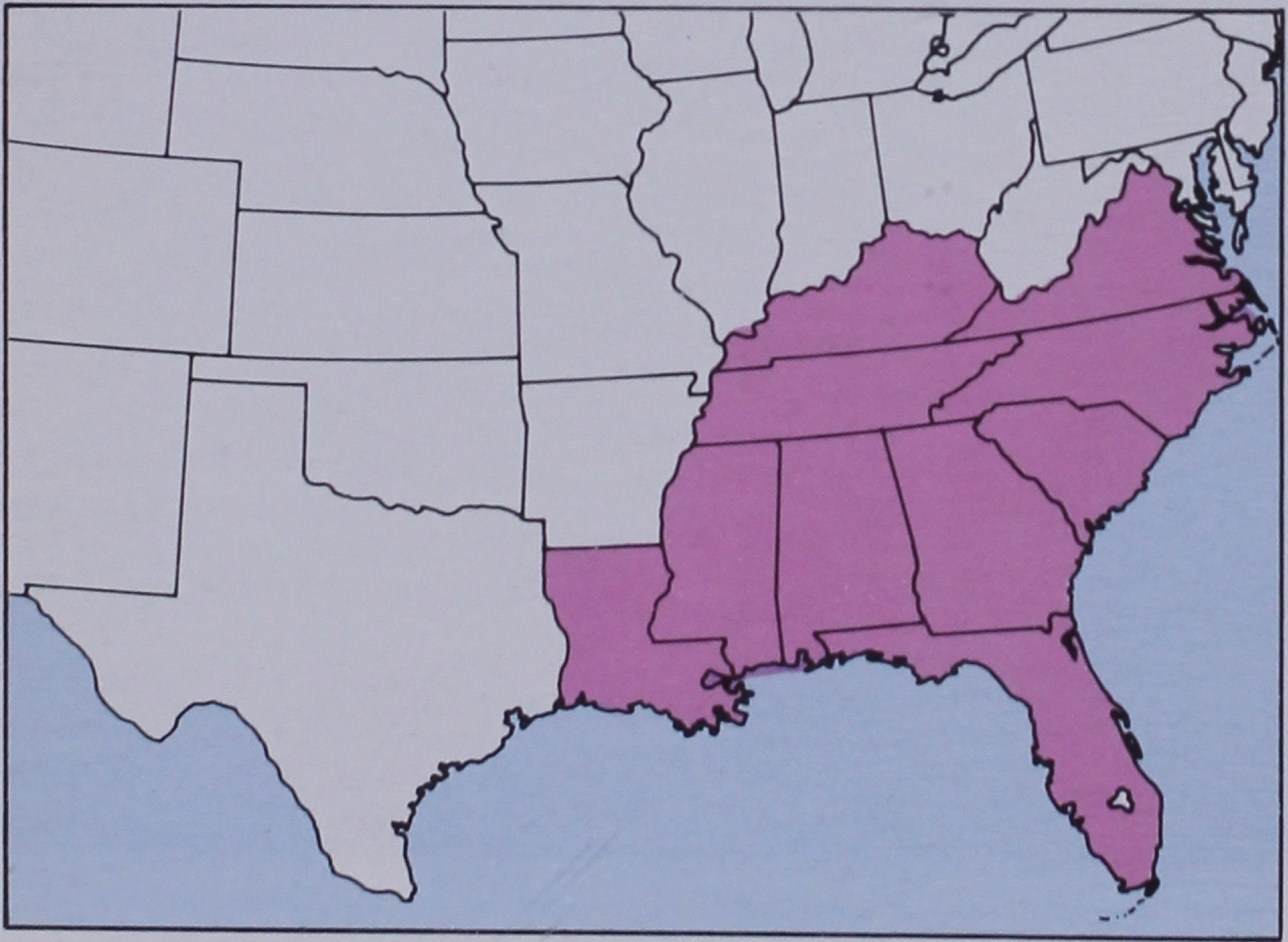


Figure 23—*States in which pitch canker has been reported in 1978.*

Nursery Diseases

Root rots. Charcoal or black root rot, caused by *Macrophomina phaseolina* (Maub.) Ashby (*Sclerotium batiticola* Tanb.) and *Fusarium* spp., caused widely scattered and locally severe damage to several pine species in many Southern nurseries. It was found for the first time in the Morgan County State Nursery in eastern Kentucky. This fungus damaged several million loblolly and slash pine seedlings in a Georgia State nursery, and 30,000 1–0 Austrian pines in an Oklahoma nursery. It also caused minor losses in other nurseries in Georgia, South Carolina, Louisiana, and Kentucky.

Cylindrocladium root rot is caused by *Cylindrocladium scoparium* Morg. and *C. floridium* Sobers & Seymour. This disease caused localized severe damage to a variety of hardwood seedlings. *C. scoparium* has been associated with root rot, stem canker, and foliage necrosis and discoloration on eucalyptus in a State nursery and in field plantings in south Florida. It was also detected in seedbeds, which had several thousand damaged black walnut seedlings, at the Baucum State Nursery in Arkansas. *C. floridium* was repeatedly isolated from damaged 1–0 sweetgum seedling roots at the West Virginia Paper Company Nursery near Summerville, S.C. Scattered mortality and stunting were observed througout the 250,000 sweetgum seedling crop.

Phytophthora and Pythium root rots, caused by several species of *Phytophthora* and *Pythium*, brought about widespread seedling losses in southern nurseries. These fungi, alone or in combination with the nursery disease fungi previously mentioned, have caused the loss of 50,000 Fraser fir seedlings at the Linville State Nursery in North Carolina, three million loblolly and slash pine seedlings in a Texas State nursery, and several thousand black walnut seedlings at the Baucum State Nursery in Arkansas.

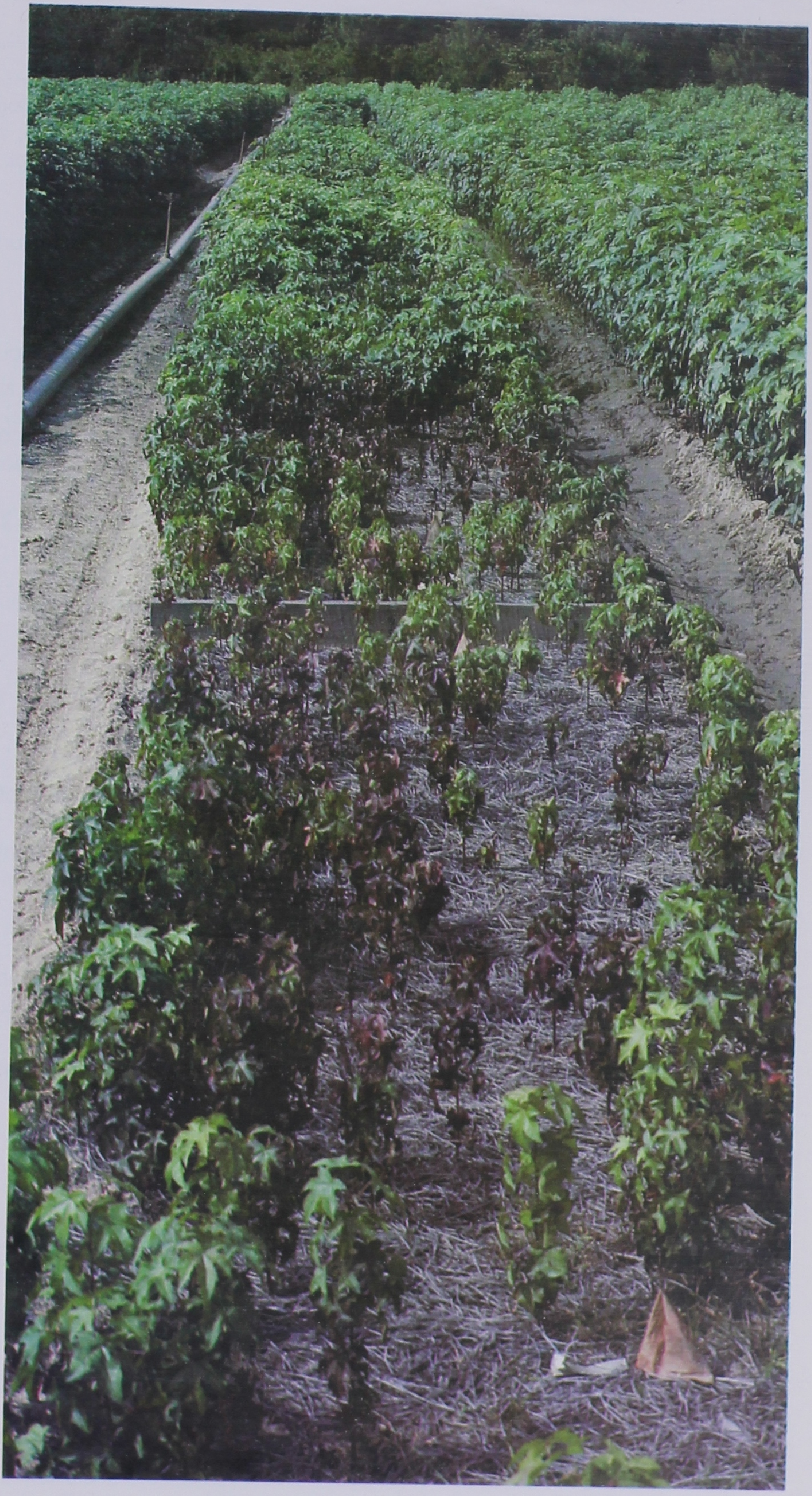
Soil fumigation with methyl bromide-chloropicrin formulations (such as methyl bromide-67 percent + chloropicrin-33 percent or methyl bromide-98 percent + chloropricin-2 percent) applied before seedlings are planted, provides the most efficient and effective control of these root rot diseases in forest tree nurseries. The first formulation is most effective against soil pathogenic fungi, particularly those such as *Cylindrocladium*, which have tough, resistant sclerotial propagules.

Few problems were reported with fusiform rust in nurseries, primarily because of intensive ferbam fungicidal spray programs and hot dry weather that prevailed during the spring and early summer rust infection period. However, 3-percent rust infection was observed on slash pine seedlings at the Munson State Nursery in western Florida in July.

Foliage Diseases

A needle cast or foliage blight again caused severe damage to approximately 2 million 2-0 eastern white pine seedlings at the Edwards State Nursery in western North Carolina. The foliage fungus *Pestalotia* sp. and the soil fungus *Fusarium* sp. are the suspected causes. Protective foliage fungicidal sprays effectively controlled the disease on the foliage of 2-0 eastern white pine seedlings in several southern nurseries during past years. Control treatments were modified at the Edwards Nursery during 1978, resulting in the reoccurrence of the extensive and severe disease symptoms on white pine foliage.

The nursery diseases mentioned above caused the loss of approximately 6 million seedlings. This represents a cost of over $250,000 in seedling production. Additional costs from seedling failure after planting is difficult to estimate.



Cylindrocladium root rot symptoms and damage on 1-0 sweetgum seedling in a South Carolina industry nursery.

F-701525

Other Diseases (R-8)

Disease	Host	Location	Remarks
Brown spot needle blight, *Scirrhia acicola* (Dearn.) Sigg.	Longleaf and slash pines	Alabama, Florida, Louisiana, and Mississippi.	Light damage in most areas, with severe losses in localized stands.
Comandra blister rust, *Cronartium comandrae* Pk.	Loblolly pine	Bledsoe County, Tenn.	Twenty percent of the trees in a stand were killed.
Diplodia tip blight, *Diplodia pinea* (Desm.) Kickx.	Scots pine	Elizabeth County, Ky.	Branch dieback.
Littleleaf disease, *Phytophthora cinnamomi* Rands	Shortleaf pine	Kentucky and Tennessee.	Decline on several thousand acres.
Pine needle rust, *Coleosporium* sp.	Hard pines	Throughout the South.	Little damage, but widespread.
White pine blister rust, *Cronartium ribicola* J.C. Fisch.	Eastern white pine	North Carolina and Virginia.	Low throughout known range. Infection remains low in parts of Virginia, even though ribes eradication had been stopped.
White pine needle fall, cause unknown	Eastern white pine	Mountains of North Carolina.	Last year's needles turned brown and dropped.
White pine root decline, *Verticicladiella procera* Kensl.	Eastern white pine	Dawson, Ky.	Scattered dying of white pine, primarily on wet sites.
Winterkill	Loblolly, shortleaf, and Virginia pine	Hedglin, Eabill, and Harris Counties, Va.	Severe growth loss, with low mortality.
Actinopelete leaf spot, *Actinopelete dryina* (Sacc.) Hoehn.	Red oaks	From Arkansas to Virginia.	Severe on pin oak.
Decay, primarily fungi in the Polyporaceae	All species	Throughout the South.	Causes about 80 percent of the total volume losses from insects and diseases. Included as a pest of lesser importance because of few field reports.
Hypoxylon canker, *Hypoxylon atropunctatum* (Schw. ex Fr.) Cke.	Red oak group	Georgia, North Carolina, South Carolina, and Tennessee.	Scattered mortality in weakened trees.

Other Diseases (R-8) *(Continued)*

Disease	Host	Location	Remarks
Oak anthracnose, *Gnomonia quercina* Kleb.	Red and white oaks	North Carolina and Virginia.	Defoliation was light to moderate especially in the mountains.
Oak decline, cause unknown	Oak	Arkansas, North Carolina, Louisiana, Mississippi, and Texas.	Scattered throughout host range.
Oak leaf blister, *Taphrina caerulescens* (Mont. & Desm.) Tul.	Red oaks	Florida, Georgia, Kentucky, North Carolina, South Carolina, and Tennessee.	Scattered throughout range, but not severe enough to cause defoliation.
Oak wilt, *Ceratocystis fagacearum* (Bretz) Hunt	Oak	Throughout known range of oak wilt.	Several new infection centers were found. The disease remains endemic.
Root rots, *Armillariella mellea* (Vahl. ex Fr.) Karst.; *Clitocybe tabescens* (Scop. ex Fr.) Bres.; *Phaeolus schweinitzii* (Fr.) Pat.; *Phytophthora* sp.	All species	Throughout the South.	Mortality was light overall, but caused losses as high as 50 percent in individual stands.
Eucalyptus leaf diseases, *Gloeosporium* sp.; *Cylindrocladium scoparium* Morg.; *Alternaria* sp.; *Pestalotia* sp.	Eucalyptus	Florida.	Damage was very light.
Butternut canker, *Sirococcus* sp.	Butternut	Arkansas to Virginia.	Most of the sapling and larger trees are dead or infected.
Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor.	Elm	Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee.	Up to 80 percent losses have occurred in old infected areas, while other areas have just lost the first tree.
Chestnut Blight, *Endothia parasitica* (Murr.) P.J. & H.W. And.	American chestnut	Throughout chestnut range.	Almost complete mortality of older trees.
Walnut anthracnose, *Gnomonia leptostyla* (Fr.) Ces. & de Not.	Black walnut	Throughout black walnut range.	Moderate to complete defoliation occurred in August.

Other Diseases (R-8) *(Continued)*

Disease	Host	Location	Remarks
Melampsora rust, *Melampsora medusae* Thum.	Poplars	Throughout poplar range.	Premature defoliation.
Sycamore anthracnose, *Gnomonia platani* Edg.	American sycamore	Throughout range of sycamore.	Sycamores severely defoliated, branch dieback common, but mortality was low.
Mimosa wilt, *Fusarium oxysporum* (Schl.) em Snyd. & Hams.	Mimosa	Florida, Georgia, North Carolina, and South Carolina.	Many trees killed. Resistant trees are being used to replant.
Fusarium canker, *Fusarium solani* (Mart.) App. & Wr. em Snyd. & Hans.	Yellow poplar, black walnut	Tennessee.	Up to 50 percent mortality in grafted seed orchards.
Drought	Maple, oak, poplar, and chestnut	Throughout the area.	Wilting and leaf fall in many trees, and death of severely stressed trees.
Deer damage	Pine	North Carolina.	Losses high in eastern North Carolina.

Mycorrhizae

Pisolithus tinctorius (Pers.) Coker & Couch, is a mycorrhizal fungus that is capable of a beneficial relationship with tree roots (the fungus gains nutrients from the plant and also increases the rate of absorption of nutrients by the plant). It is being evaluated for its ability to infect nursery seedlings and to increase the survival of these seedlings when they are outplanted on adverse sites. This evaluaton, coordinated by the Southeastern Area State and Private Forestry Group, Asheville, N.C., was established in 33 nurseries in 28 States, nationwide.

Preliminary results from 16 nurseries in 14 States (primarily in the Southwest and West) showed that when a good strain of the fungus was used, there was a 14-percent increase in seedlings' fresh weight, and a reduction of 32 perent in seedlings culled when graded at the nursery. This reduction in culls could lower the annual cost of seedling production in southern nurseries by $850,000.

Eastern Region (R-9)[1] and Northeastern Area

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The spruce budworm, gypsy moth, and forest tent caterpillar were the most important insects in the Northeastern Area in 1978. The spruce budworm defoliated 7.7 million acres of spruce and fir in Maine, New Hampshire, Vermont, Michigan, Minnesota, and Wisconsin. Severe defoliation is expected in 1979.

The gypsy moth defoliated 1.3 million acres in 9 States. The area defoliated by this insect increased in Connecticut, Maine, New Jersey, New York, and Vermont; remained the same in New Hampshire; and decreased in Massachusetts and Pennsylvania.

The forest tent caterpillar defoliated 627,000 acres in Indiana, Minnesota, Wisconsin, Massachusetts, New York, and Vermont.

Scleroderris canker of red pine (European strain) extended outside the boundaries set in 1977 in New York and Vermont. It is suspected to be in New Hampshire; none has been found in the Lake States.

Nursery diseases caused significant losses both in nurseries and after outplanting of seedlings.

Status of Insects

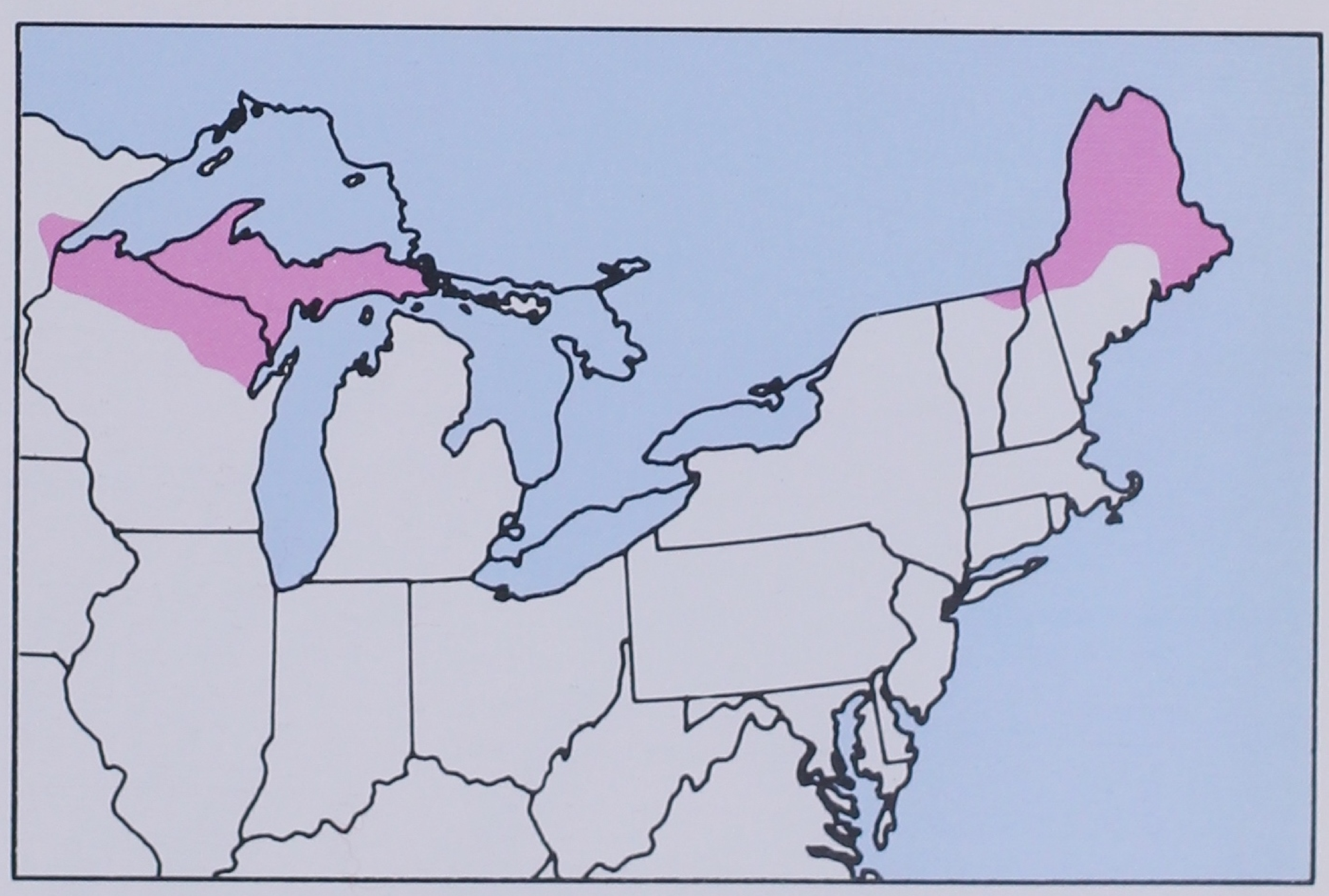
Spruce budworm, *Choristoneura fumiferana* (Clem.). The spruce budworm was the major pest in the Northeastern Area. The primary host is balsam fir, but most of the spruces are also attacked. Total area defoliated increased from about 6.4 million acres in 1977 to about 7.7 million acres in 1978. A major increase occurred in Maine, where nearly the whole northern half of the State was defoliated. Some increase in defoliation was reported from Vermont, but it represented mostly areas within the periphery of the existing outbreak. Elsewhere, defoliation decreased or remained nearly the same as last year. Indications are that spruce budworm populations are declining in all areas except Maine.

Repeated severe defoliation has affected the growth and survival of balsam fir forests in the Northeastern Area. Dead trees are common in Minnesota, Michigan, and Wisconsin, where repeated defoliations have occurred for many years. Mortality is beginning in small areas in New Hampshire. Scattered small groups of dead trees are common throughout most of Maine. In a few areas, covering several thousand acres each, tree mortality exceeds 25 percent of the commercial volume. These are areas where adequate protection was not possible. In 1970 forest growth had exceeded drain (harvesting and mortality from insects and diseases). There has been no increase in total balsam fir volume during the last 3 years. Growth has slowed to the point where growth and drain are equal.

About 1.1 million acres in Maine were sprayed in 1978. Sevin® 4 Oil, Orthene® Forest Spray, Dylox® 4, and Thuricide® 16B were the insecticides used. Poor weather caused delays, and about 100,000 acres had to be dropped from the project because the budworm had begun to pupate. Spruce budworm survival in 1978 was good, and population density, determined from egg

Table 8.—*Spruce budworm infestations in the Northeastern Area States*

State	Thousand acres 1977	Thousand acres 1978
Maine	5,700	7,000
Michigan (Upper Peninsula)	300	300
Minnesota	150	54
New Hampshire	110	110
Vermont	44	62
Wisconsin	140	140
Total	6,444	7,666



Spruce budworm distribution in the Northeastern Area.

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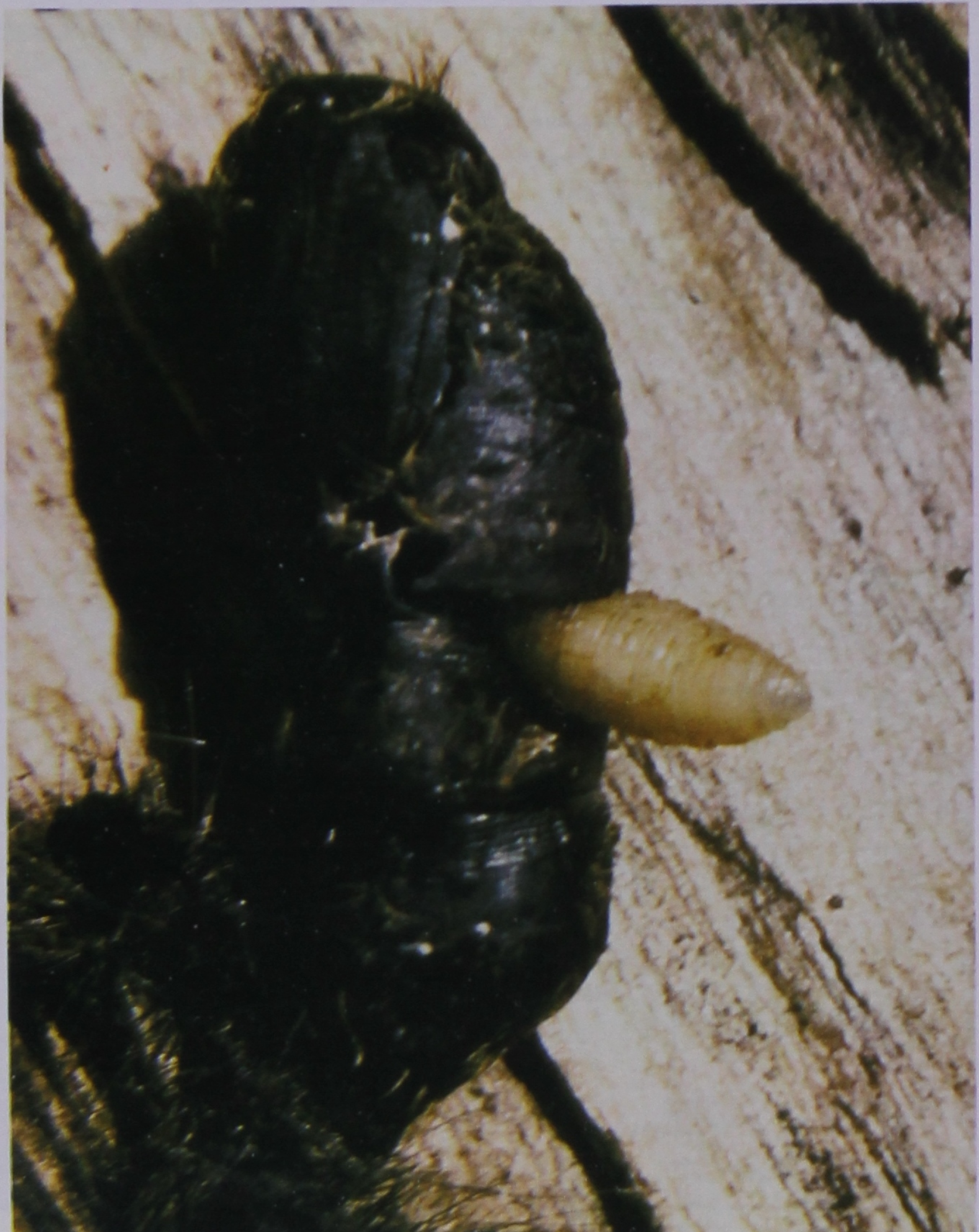
[1] Includes forests in Connecticut, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, Maine, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

Table 9.—*Area defoliated by the Gypsy moth infestations in the Northeastern Area States*

State	Thousand acres 1977	Thousand acres 1978
Connecticut	0	4
Maine	2	4
Massachusetts	133	63
New Hampshire	Less than 1	Less than 1
New Jersey	42	205
New York	91	500
Pennsylvania	1,296	453
Rhode Island	Less than 1	0
Vermont	8	40
Total	1,574	1,270



Gypsy moth pupa with a parasitic tachinid emerging from it. Effectiveness of these parasites in reducing gypsy moth numbers is difficult to determine.

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mass surveys, has increased. Predicted hazard conditions, based on tree condition and anticipated defoliation, show that unless additional defoliation is prevented, tree mortality may occur on over 5 million acres in 1979. Maine is considering spraying 3.5 million acres in 1979. Another 1.5 million acres is in ''no-spray'' areas such as parks and buffers along water, major highways, and population centers.

Gypsy moth, *Lymantria dispar* (L.). The gypsy moth caused extensive defoliation of hardwoods on about 1.3 million acres in 1978. Oaks are the primary hosts, but most hardwoods and some conifers may also be defoliated. Overall defoliation was less in 1978 than in 1977, but most of the decrease was reported in Pennsylvania. Most of the other States reported increased area defoliation. Populations spread into Ohio, West Virginia, and Virginia and populations increased in Michigan and Wisconsin.

In 1979 the area defoliated by the gypsy moth is expected to increase in most States except Pennsylvania, where further decrease in likely.

Many States reported parasite releases to establish new parasites or to increase the numbers of those present. The effectiveness of the releases is difficult to determine.

The major impact of gypsy moth defoliation in 1979 was to esthetic values. However, some tree mortality in forest stands was reported in Pennsylvania.

Insecticides were commonly used in high value areas to prevent defoliation by the gypsy moth. About 135,000 acres were treated in Pennsylvania with Dylox® 1.5; 32,000 acres in New Jersey with Sevin® 4 Oil; and about 13,000 acres in New York with Dipel and Thuricide® 16B.

Other Insects (R-9)

Insect	Host	Location	Remarks
Birch casebearer, *Coleophora serratella* (L.)	Birches	Maine.	Spotty; increasing; some tree mortality.
Birch leaf miner, *Fenusa pusilla* (Lep.)	Birch, white and grey	Maine, New Hampshire, Rhode Island, and Vermont.	Widespread; static.
Balsam gall midge, *Paradiplosis timifex* Gagne (formerly identified as *Dasineura balsamicola* (Lint)	Balsam fir	Wisconsin and Vermont.	Increasing; Christmas tree problem primarily.
Balsam twig aphid, *Mindarus abietinus* Koch	Balsam fir	Maine and Vermont.	Increasing; in Christmas tree plantations.
Fall cankerworm, *Alsophila pometaria* (Harr.)	Hardwoods	Minnesota.	Population low; decreasing.
Spring cankerworm, *Paleacrita vernata* (Peck)	Hardwoods	Massachusetts, New Jersey, New York, Rhode Island, and West Virginia.	Population low; decreasing.
Eastern tent caterpiller, *Malacosoma americanum* (Fab.)	Cherries, apples	United States.	Common; increasing.
Fall webworm, *Hyphantria cunea* (Drury)	Hardwoods	NE. United States.	Common; locally heavy; mostly decreasing.
Forest tent caterpillar, *Malacosoma disstria* (Hbn.)	Oaks, sugar maple, birches	Indiana.	500,000 acres infested; disease and parasites are expected to cause a collapse.
Forest tent caterpillar, *Malacosoma disstria* (Hbn.)	Aspen, oaks, hardwoods	Minnesota.	Several million acres; heavy defoliation along Northern border; increased.
Forest tent caterpillar, *Malacosoma disstria* (Hbn.)	Aspen, hardwoods	Michigan's Upper Peninsula.	100,000 acres defoliated; heavy parasitism; collapse expected.
Forest tent caterpillar, *Malcosoma disstria* (Hbn.)	Sugar maple, hardwoods	New Hampshire, Massachusetts, New York, and Vermont.	Increasing aerial control tests in Vermont in 1978.
Forest tent caterpillar, *Malacosoma disstria* (Hbn.)	Aspen, oak	Northern Wisconsin.	Increasing; 27,000 acres defoliated.

Other Insects (R-9) *(Continued)*

Insect	Host	Location	Remarks
Green fruitworm, *Lithophane antennata* (Walker)	Silver maple, boxelder, ash	Indiana.	In bottomlands, defoliated 10,000 acres; increase in 1978.
Lithophane latincerea (Grt.)	Silver maple	Iowa.	Locally heavy.
Greenstriped mapleworm, *Dryocampa rubicunda* (Fabricius)	Silver maple, maples, birches	Missouri, Iowa, Maine.	Light defoliation on 2,000 acres; increasing. Spotty in low areas in SE. Maine; increasing.
Jack pine budworm, *Choristoneura pinus* Free.	Jack pine, red pine	Michigan, Minnesota, and Wisconsin.	Low; static in Michigan; increasing in Minnesota and Wisconsin. 85,000 acres infested.
Larch casebearer, *Coleophora laricella* (Hbn.)	European larch	Vermont.	Light defoliation; static.
Larch sawfly, *Pristiphora erichsonii* (Hart.)	Tamarack, European larch	Michigan, Wisconsin, Maine, Rhode Island, and Massachusetts.	Locally heavy and increasing in Lake States; decreasing in Maine and Massachusetts.
Large aspen tortrix, *Choristoneura conflictana* (Wlk.)	Aspen	Minnesota.	Light defoliation; increasing populations.
Locust leafminer, *Odontota dorsalis* (Thunb.)	Black locust	Minnesota, Vermont, and West Virginia.	Scattered; static.
Looper and tier complex Geometridae, Tortricidae, Gelechiidae, etc.	Hardwoods	Missouri.	1 million acres with about 50 percent defoliation; increasing.
Maple leafcutter, *Paraclemensia acerifoliella* (Fitch)	Sugar maple	Vermont.	About 60,000 acres; static; some aerial spraying.
Nantucket pine tip moth, *Rhyacionia frustrana* (Comst.)	Pitch pine, short leaf pine, Scots pine	Massachusetts, Missouri, and West Virginia.	Light and scattered; static to decreasing populations.
Oak leafrollers, leaf tiers complex: *Archips* sp, *Argyrotaenia* sp., *Pseudexentera* sp., *Croesia* sp., and others	Oaks	Connecticut, Maine, Massachusetts, Michigan, West Virginia, Minnesota, and New Jersey.	About 190,500 acres defoliated, some mortality. Defoliation expected to increase.
Orangestriped oak worm, *Anisota senatoria* (J.E. Smith)	Oaks	Massachusetts.	150 acres defoliated.
		SE. New Jersey.	5,000 acres defoliated, some branch dieback.

Other Insects (R-9) *(Continued)*

Insect	Host	Location	Remarks
Pinkstriped oak worm, *Anisota virginiensis* (Drury)	Oak, beech, birch	Maine.	About 100 acres defoliated; population decreasing.
Oak borers complex, *Goes* sp.; *Hammoderus* sp.; and *Enaphalodes* sp.	Oaks	Southern Missouri.	Severe timber losses; annual problem; static.
Pales weevil, *Hylobius pales* (Herbst.)	Scots pine	Indiana, Maryland, and Missouri.	Locally heavy.
Palmerworm, *Dichormeris ligulella* Hubner	Oaks, hardwoods	Maryland, Ohio, and Pennsylvania.	Infestation increased and became locally heavy.
Pine engraver, *Ips pini* (Say)	Red pine	Michigan, Minnesota, and Vermont.	Small pockets killed.
Pine needleminer, *Exoteleia pinifoliella* (Chambers)	Pitch pine	Massachusetts.	About 6,000 acres.
European pine sawfly, *Neodiprion sertifer* (Geoffrey)	Austrian pine, Scots pine	Iowa, Michigan, and Missouri.	Locally heavy and increasing.
Redheaded pine sawfly, *Neodiprion lecontei* (Fitch)	Hard pines	Missouri and New York.	Local infections; generally light.
Pine tortoise scale, *Toumeyella parvicornis* (Cockerell)	Virginia pine	Pennsylvania.	Heavy in one plantation.
Pine root collar weevil, *Hylobius radicis* Buchanan	Jack pine, red pine, Scots pine	Michigan and Wisconsin.	Common; perennial problem.
Post-oak locust, *Dendrotettix quercus* (Packard)	Oaks (also on pines)	Missouri.	Light to moderate static infestation.
Red pine scale, *Matsucoccus resinosae* Bean and Godwin	Red pine, Japanese red and black pines, Chinese pine	Connecticut, New Jersey, and New York.	Some new infestations.
Saddled prominent, *Heterocampa guttivitta* (Walker)	Sugar maple	Maine, Michigan, and New York.	No defoliation, but some tree mortality from previous damage in Maine. About 60,000 acres lightly defoliated in Michigan. Increasing in New York

Other Insects (R-9) *(Continued)*

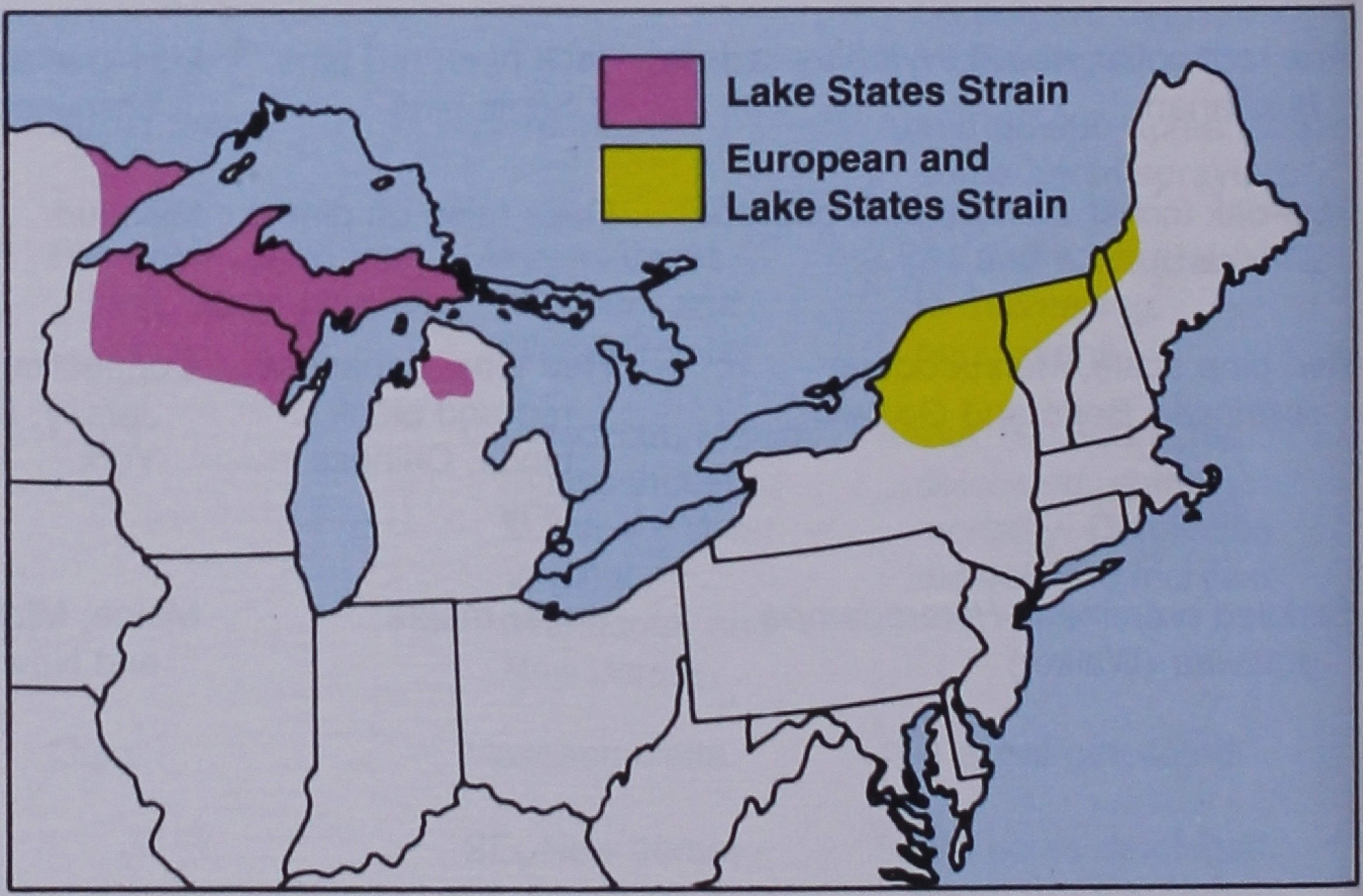
Insect	Host	Location	Remarks
Pine spittlebug, *Aphrophora parallela* (Say)	Eastern white pine, Scots pine	Maine, Massachusetts, and Vermont.	Scattered static infestation.
Saratoga spittlebug, *Aphrophora saratogensis* (Fitch)	Red pine	Maine and Wisconsin.	1,000 acres infested.
Twolined chestnut borer, *Agrilus bilineatus* (Web.)	Oaks	Indiana.	Scattered dying trees in central oak area.
Twig pruner, *Elaphidionoides villosus* (Fabricius)	Oaks	Indiana.	Locally heavy.
Yellowheaded spruce sawfly, *Pikonema alaskensis* (Rohwer)	White spruce	Maine and Minnesota.	Locally heavy, static infestation; 95 acres sprayed.
		Vermont.	Increasing.
Walking stick, *Diapheromera femorata* (Say)	Black oak, other oaks, black locust	Maryland and West Virginia.	Increasing; local infestations.
Walnut caterpillar, *Datana integerrima* Grote & Robinson	Black walnut, butternut hickory	NE. States.	Common; static.
White pine weevil, *Pissodes strobi* (Peck)	White pine, Norway spruce	NE. States.	Common; static.

Status of Diseases

Scleroderris canker, caused by *Gremmeniella abietina* (Lagerb.) Morelet. Two strains of *Gremmeniella* are now recognized—the Lake States strain and the European strain. The European strain is much more virulent than the Lake States strain, which only kills trees less than 6 feet in height.

The Lake States strain is common in northern Michigan, Minnesota, New York, Vermont, and Wisconsin. The most commonly damaged hosts are red pine, Scots pine, and jack pine, but other conifers are occasionally infected.

A new wave of infections was reported in 1978 in the Lake States, particularly in upper Michigan. In many plantations in Luce and Schoolcraft



Distribution of scleroderris canker in the Northeastern Area.

Counties, more than one-third of the trees were dead, and the remaining trees were infected. Increased intensity was also reported in Wisconsin. A new infection center was found near Iron River, Wisc. The European strain has not been found on the National Forests in the Lake States.

In the Northeastern States, New York has the most widespread infections by the European strain. In 1977, 10 counties were placed under a quarantine, which includes both strains of the disease. In 1978, infected plantations were found outside the quarantine area in 17 towns. The disease is also increasing in intensity and frequency within the quarantine area. Of 128 plantations sampled in 1978, 85 percent were infected as compared to 60 percent in 1973. Entire plantations, some 50 to 60 years old, have been killed.

In Vermont, a quarantine was established against the European strain in 1977 in 22 towns. In 1978, 13 new towns were found infected outside the quarantine.

In Maine, scleroderris canker was found for the first time this year. The disease is present in an 800-acre natural red pine stand in the western part of the State. Serological tests have confirmed that the disease in this stand is caused by the Lake States strain.

Most recently, a first State record was also confirmed in New Hampshire. Field symptoms on red pine and appearance of the cultures suggest that the European strain is present. Serological tests will be made for confirmation.

Dutch elm disease, caused by *Ceratocystis ulmi* (Buism.) C. Mor. Dutch elm disease is present in all 20 States in the Northeastern Area. A few new counties in Minnesota and Missouri recorded the disease. Tree mortality is most frequent in the Midwest. Many communities practice sanitation; some practice tree injection with a fungicide to reduce the rate of tree mortality.

Federal funding became available in 1978 for Dutch elm disease control. In cooperation with the Wisconsin Department of Natural Resources and small urban communities, 20 demonstration areas were established to show the best known control methods. Similar control demonstration areas were established in six Minnesota communities in cooperation with the Minnesota Department of Natural Resources. Cooperative funding was provided to the Stillwater State Prison in Minnesota to develop a wood pelletizing facility to process 40,000 to 80,000 tons of salvaged elm trees from the Twin Cities area. Some of the pellets produced will be used at the Prison heating plant and some will be sold for use by local industry.

Other Diseases (R-9)

Disease	Host	Location	Remarks
Anthracnose, caused by *Gnomonia platani* Edg.	American sycamore	Missouri, New Jersey, Pennsylvania, and West Virginia.	Statewide; slight increase.
Ash dieback, cause unknown	White ash	Indiana, Ohio, and Vermont.	Locally heavy mortality.
Aspen leaf spot, caused by *Venturia* spp.	Large tooth aspen	Wisconsin.	Complete defoliation of some clones.
Beech bark disease, caused by *Nectria coccinea* var. *faginata* (Loh., Wats, Ay.) and bark scales	American beech	Maine and Vermont.	Impact survey shows past mortality at 15-25%; mortality rate presently low.
		New York.	Moving westward; some tree mortality in central counties.
		Pennsylvania.	Disease moving from NE, to SW.; no mortality yet.
Birch decline, cause unknown	Paper birch, oaks, and black locust	Wisconsin.	Locally heavy tree mortality; declining as old trees disappear.

Other Diseases (R-9) *(Continued)*

Disease	Host	Location	Remarks
Black walnut dieback, caused by fusarium canker and *Xylosandrus germanus* (Blandford)	Black walnut	Indiana.	Locally heavy in plantations.
Brown spot needle blight, caused by *Scirrhia acicola* (Dearn.) Sigg.	Scots pine	Missouri.	Heavy losses in some Christmas tree plantations; decreasing.
Butternut decline, caused by *Sirococcus* sp.	Butternut	Indiana.	First 4 trees died in Spencer County.
		Minnesota.	Spreading to West.
		Wisconsin.	Disease common throughout; heavy mortality.
Cytospora canker, caused by *Cytospora kunzei* (Desm.) Kickx.	Spruce	Rhode Island.	
Diplodia tip blight, caused by *Diplodia pinea* (Desm.) Kickx.	Red pine, jack pine, ponderosa pine, and Scots pine	Indiana, Massachusetts, and New Jersey.	Increasing
		Minnesota.	Decreasing
Annosus root rot and butt rot, caused by *Fomitopsis annosa* (Fr.) Karst.	Short leaf pine, conifers, black locust	Missouri.	Low level.
		Vermont.	Increasing; borax treatments used.
Fusarium canker, caused by *Fusarium* spp.	Black walnut	Indiana.	Damage reported from 8 counties increasing.
Hickory decline, cause unknown	Hickory	Indiana.	Mortality reported from NW. State.
Larch decline, cause unknown	Eastern larch	Vermont.	Total about 300 acres in scattered areas with dead and dying trees.
Lophodermium needlecast, caused by *Lophodermium pinastri* (Schrad. ex Hook.) Chev.	Red and Scots pine	West Virginia and Vermont.	Light infestation and damage.
Oak mortality, cause unknown	Oaks	Indiana and Iowa.	May be related to weather stress.
Oak wilt, caused by *Ceratocystis fagacearum* (Bretz) Hunt	Oaks	Indiana, Iowa, Missouri, Minnesota, Ohio, West Virginia, and Wisconsin.	Common; generally static, locally serious.

Other Diseases (R-9) *(Continued)*

Disease	Host	Location	Remarks
Phoma canker, caused by *Phoma* spp.	European black alder	Indiana.	Infection and mortality in 2 nurseries.
Red pine shoot blight, caused by *Sirococcus strobilinus* Preuss	Red pine	Wisconsin, and Minnesota.	Increased in northern counties.
Rhabdocline needle cast, caused by *Rhabdocline pseudotsugae* Syd.	Douglas-fir	Wisconsin.	First discovery; 1 plantation; 70% Christmas trees not merchantable.
Shoestring root rot, caused by *Armillariella mellea* (Vahl. ex Fr.) Karst.	Oaks	Indiana.	Mortality in pockets.
	Sugar maple	Pennsylvania.	Mortality in 200-acre logged area.
Sweetfern rust, caused by *Cronartium comptoniae* Arth.	Loblolly pine	Maryland.	300-acre plantation with 30% trees infected.
Yellow birch canker, caused by *Diaporthe alleghaniensis* R.H. Arn. and *Gnomonia setacea* (Pers. ex Rf.) Ces de Not.	Yellow birch	New Hampshire and Vermont.	Disease common on seedlings, causes mortality of trees up to 3″ diameter.
White pine blister rust, caused by *Cronartium ribicola* J.C. Fisch.	Eastern white pine	NE. States.	Generally common; static.
White pine root decline, caused by *Verticicladiella procera* Kensl.	Eastern white pine	Indiana, West Virginia, and Pennsylvania.	In plantations; increasing.
Winter injury	Shortleaf and loblolly pine	Ohio and West Virginia.	1,000 acres dead; 25,000 acres with ice damage.

Indiana, West
Virginia, and
Pennsylvania.

Alaska Region (R-10)

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Conditions in Brief

Bark beetles caused the most insect damage in Alaskan forests in 1978. Infestations covered 125,927 acres throughout south-central and interior Alaska. Heavy white spruce mortality occurred on 15,322 acres of the Chugach National Forest; an increase of 2,821 acres over the area infested in 1977. Killing of white spruce by *Ips* occurred on 1,977 acres along the Porcupine River. Eastern larch beetle infestations in the interior decreased dramatically from 531,998 acres in 1977 to 35,589 acres in 1978.

Blotch miners and the large aspen tortrix caused the most widespread defoliation in Alaska. Tortrix larvae defoliated 21,120 acres of aspen in south-central Alaska. Blotch miners damaged about 515,999 acres of aspen and alder near Fairbanks. Large numbers of spruce budworm larvae were collected for the first time in localized areas around Anchorage and on the Kenai Peninsula.

In southeast Alaska, western black-headed budworm and hemlock sawfly populations were endemic. Moderate and scattered spruce aphid damage to Sitka spruce occurred at Point Vandeput in the Thomas Bay area of the Stikine Area and at the Sitka National Monument near Sitka, Alaska. Populations of the saddleback looper, a defoliator of western hemlock, were light but increasing south of Frederick Sound.

Hemlock dwarf mistletoe, sirococcus shoot blight, and needle rust of white and black spruce were again the most damaging tree diseases in Alaska. A total of 691,000 acres of white spruce were lightly infested and 73,233 acres heavily infested by the needle rust along the Porcupine and Yukon Rivers in interior Alaska. Frost and air pollution had an impact in some local areas.

Status of Insects

Spruce beetle, *Dendroctonus rufipennis* (Kby.). The spruce beetle was the single most damaging forest insect in Alaska, infesting approximately 125,900 acres throughout south-central and interior Alaska. White spruce mortality occurred on 15,322 acres of the Chugach National Forest, an increase of 2,821 acres (18 percent) over the acreage infested in 1977. This increase was a result of a new 2,041-acre infestation along Summit Lake and 780 acres of scattered beetle-caused white spruce mortality around Upper Russian Lake. Spruce trees are still being killed on 8,599 acres of the 12,500-acre spruce beetle infestation along the Resurrection Creek Drainage on the Kenai Peninsula, a high value recreation area. Spruce beetle activity also increased over 1977 levels elsewhere on the Kenai Peninsula. A total of 45,713 acres of white spruce was infested in the Kenai National Moose Range and Chickaloon Flats. The heaviest infestation, which occupies 7,413 acres, is located near Barbara Lake.

Spruce beetle activity on the west side of Cook Inlet has increased over the 1977 level (very little activity). Approximately 62,311 acres of very light (one infested tree per acre) white spruce mortality was detected aerially near lower Beluga Lake. This increase was of minor economic concern as most of the susceptible commercial spruce was already killed in the Tyonek outbreak of the late 1960's and early 1970's. Salvage operations are continuing on these affected State lands. As of October 1978, a total of 58.9 million board feet of white spruce had been harvested on the Westside Salvage Timber Sale. Seventy-five percent of this volume was beetle-killed timber.

A total of 2,579 acres of light spruce beetle activity was detected in the interior. The largest infestation, 2,325 acres, was about 7 miles south of Devils' Elbow on the Kuskokwim River.

Eastern larch beetle, *Dendroctonus simplex* LeC. Eastern larch beetle infestations in the interior decreased dramatically from 532,000 acres in 1977 to 35,590 acres in 1978. The infestation is moving northeastward from the upper Kantishna River drainage where it originated in 1974. Scattered mortality occurred along the Tanana River near Fairbanks.

Tamarack is widely scattered over much of the area with localized concentrations of fairly dense growth. Most of the susceptible tamarack has been infested in the last 3 years and the larch beetle outbreak seems to have run its course.

Larch aspen tortrix, *Choristoneura conflictana* (Wlk.). From 1966 to 1969 about 10,000 square miles of aspen in the interior were defoliated by this insect. From 1969 to 1978, populations were endemic. In 1978 aspen defoliator populations increased dramatically, heavily defoliating a total of 21,120 acres in south-central Alaska. This infestation was located about 3 miles southwest of Willow. Total defoliation occurred on many sites.

Tortrix populations also are increasing gradually in the interior aspen forests. However, damage in 1978 was minimal and was detected only by ground surveys. Tortrix populations will be monitored carefully throughout the 1979 field season.

Leafrollers, *Epinotia solandriana* L. and *Archips* spp. Leafroller activity in south-central Alaska significantly decreased from the 51,891 acres infested in 1977 to 14,502 acres. Most of this defoliation occurred in the Anchorage bowl. However, increased tree mortality, especially in urban areas, occurred as a result of 3 to 4 years of consecutive defoliation.

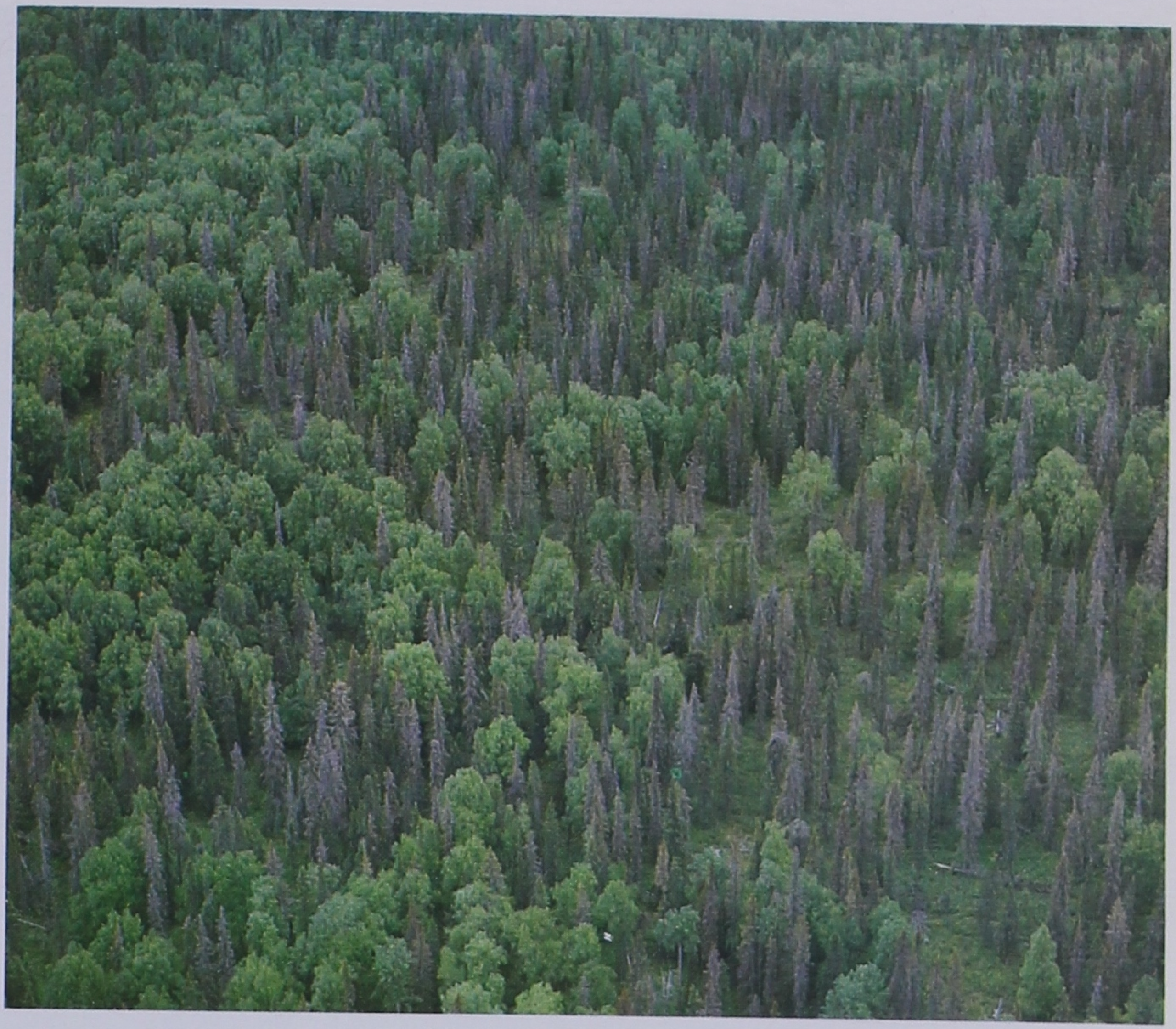
The reduction in 1978 leafroller activity was probably caused by weather conditions unfavorable for insect development. Summer temperatures were below normal and precipitation was higher than normal throughout the month of June.

Light to moderate leafroller populations defoliated aspen on 7,460 acres of poorly drained sites on the Kenai Peninsula. Some 7,000 acres of this defoliation were located between Bottenintnin Lake and Soldotna along the Sterling Highway.

Spruce budworm, *Choristoneura* sp. Significant defoliation of white spruce was detected in many residential areas and parks in Anchorage. Some budworm larvae were also collected near Hope on the Kenai Peninsula.

This is the first time that this potentially serious conifer defoliator has been found this far north. Specimens have been sent to appropriate taxonomists for identification. Efforts will be made next year to determine the life-history and the impact of this defoliator in Alaska.

Blotch miner, *Lithocolletis ontario* (Free.). Ground and aerial surveys detected blotch miner damage to quaking aspen on 516,439 acres near Fairbanks for the second year. However, little or no branch dieback or tree mortality was observed. At worst, this defoliation will probably result in a small amount of growth loss.



F–701527

White spruce on the Kenai National Moose Range killed by the spruce beetle.

Other Insects (R-10)

Insect	Host	Location	Remarks
Ips perturbatus (Eichh.)	White spruce	Porcupine River, Alaska.	Populations increasing; 1,977 acres infested.
Cottonwood leaf beetle, *Chrysomela scripta* (F.)	Cottonwood, aspen, balsam poplar	SE. and Interior Alaska.	Defoliation damaging in landscape plantings.
Cedar bark beetles, *Phloeosinus* spp.	Alaska yellowcedar, western redcedar	Tongass National Forest.	Killing root-diseased trees and trees on poor sites.
Western blackheaded budworm, *Acleris gloverana* (Walsh.)	Western hemlock, Sitka spruce	Prince of Wales Island, Alaska.	Larval populations increasing.
Hemlock sawfly, *Neodiprion tsugae* Midd.	Western hemlock	SE. Alaska.	Populations below damaging level.
Spruce aphid, *Elatobium abietinum* (Walk.)	Sitka spruce	SE. Alaska.	Defoliation and some branch killing.
Saddleback looper, *Ectropis crepuscularia* (Denis & Schiff.)	Western hemlock	SE. Alaska.	Light but increasing populations.

F-701528

Spruce needle rust affected nearly all of the current year's foliage on white spruce near Ruby, Alaska.

Status of Diseases

Hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosend.) G. N. Jones. This is one of the major forest pests in Alaska. Impact data are being collected.

Sirococcus shoot blight, *Sirococcus strobilinus* Preuss. This disease is very active on western hemlock reproduction throughout southeast Alaska. Infection was serious on 15 to 20-year-old reproduction at Yakutat. At Thomas Bay, the infection was greatest in fertilized areas. Generally, however, the disease is found in all areas—unthinned, thinned, fertilized, nonfertilized, and combinations of these treatments. Despite high levels of infection there is little damage to potential crop trees. The first incidence of *Sirococcus* infection on mountain hemlock was found on a sapling on Mitkos Island.

Armillaria root rot, *Armillariella mellea* (Vahl. ex Fr.) Karst. This disease selectively killed western hemlock throughout a 35- to 45-year-old stand of mixed hemlock–spruce on Kosciusko Island. The fungus was noted on all of the mistletoe study plots in this area. On one plot, 40 percent of the hemlock was killed.

Spruce needle rust, *Chrysomyxa ledicola* Lagh. Although spruce needle rust was endemic in south-central and southeast Alaska (618 acres of light infection), it was at epidemic level in the interior (765,717 acres affected). White and black spruce stands were lightly infected (less than 1.2 trees per acre) on 691,000 acres on the upper Porcupine River between the Canadian border and the Colleen River. In other areas, however, (73,351 acres northwest and east of Ruby and 20,015 acres in the Taylor Mountains Quadrangle and north of Dillingham), 90 percent of the current year's foliage was affected in all age classes. Such an intense epidemic may have a serious effect on the following year's growth.

Frost damage on aspen. A late frost defoliated 10,890 acres of quaking aspen southwest of Livengood (interior Alaska). Clones that leafed out early in the season were the ones damaged.

Cedar mortality. Alaska yellow-cedar continues to die throughout the northern half of southeast Alaska. The cause of the mortality seems to be a root disease in conjunction with the cedar bark beetle. The areas around Petersburg and Peril Straits are the major centers of the mortality.

Air pollution. Trees near the pulp mills at Ketchikan and Sitka continue to die. Needles of affected conifers have sulfur levels of 4,800 ppm compared with 500 to 700 ppm for trees in nonpolluted areas.

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